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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

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HIGH-SPEED ELECTRIC CAR TESTS.

The recent tests on the Berlin-Zossen experimental railroad resulted in a speed of about 125 miles an hour. This has been secured by equipping a car with sufficient power in its motors and by building a suitable roadbed. The results, while noteworthy, can hardly be said to have been unexpected, but it is nevertheless greatly to the credit of the German engineers that they have carried out the work so satisfactorily. While, from the general reports, one might be led to believe that the chief object of this work was to attain a higher speed than had been reached previously, this is only incidental to the gathering of engineering data on the high-speed running of trains. Work of this character has been done in this country, but only on an experimental scale. In the German tests the car was not only of regulation size, but carried a number of passengers, and it is said that there was no discomfort due to the exceptional speed. The work is of real importance, and it is not to be doubted that the results obtained will have a decided bearing on the operation of the express train of the future, no matter what the motive power may be.

THE ELECTRICAL FIRE HAZARD.

Why is it that insurance inspectors appear to be prejudiced against electricity? One can hardly pick up an insurance paper but what he encounters a formidable indictment of electrical wiring and a list of fires "undoubtedly caused by electricity," though seldom is a statement made as to the relative number of fires due to electricity and to other causes.

Now, it is all very well to insist upon the proper installation and proper care of electrical wiring, but these are matters which are largely under the control of the fire underwriters, and it rests with them to say whether any particular installation is safe. There is no law compelling them to ensure a building. There is a code of rules which they are perfectly able to enforce, as they have their own inspectors, and if these rules are not satisfactory they should be made so. But little good is accomplished by such unfair summaries as are frequently published. The electrical method of supplying power and light can be made as safe, or safer, than any other, and any endeavor to prejudice the public against this would seem to be working against the interests of the insurance people themselves. If they insist upon good work in the first place and proper care afterward, the result must be an improvement in the electrical hazard.

ELECTRIC HAULAGE ON CANALS.

In a recent issue of the *Revue Technique,* M. Georges Petit gives an interesting discussion of electric haulage on canals. Recognizing that the principal problem was one of traction, it is necessary to consider two methods—one in which the motor travels on an ordinary road, and the other in which it runs on rails. The first system gives a higher tractive effort for a given weight of motor, but it takes more power to move the motor itself, and the efficiency of the system is less than when the motor runs on rails. In studying the problem, the power required to overcome the inertia of the boat is easily computed from its known weight. That, however, required to overcome the friction of water when confined in a canal could only be determined experimentally, and to do this, boats were brought up to a known speed and were then allowed to drift after the tractive force had been cut off, their rate of retardation being noted. From the retardation curves and the computed inertia, acceleration and power curves were constructed, both for motors traveling on an ordinary roadbed and on rails. The results show that the rail system is superior to the other, and that it will be less expensive to keep up, although the first cost will be greater. It is the author's opinion, that mechanical haulage on canals will surely be adopted in the future, and he believes it will be entirely successful. Moreover, the systems will be operated electrically because this is the most efficient and reliable method of supplying the power.

AN INTERESTING APPLICATION OF POLYPHASE INDUCTION MOTORS.

Some time ago we made note of an interesting adaptation of polyphase motors to pumping work, in which the objection to these motors on account of their characteristic weak starting torque was neatly overcome by starting the motors with the valves closed. Under these conditions they simply circulate the water in the pumps and do but little work. After they have reached their normal speeds, the valves are opened and they at once begin pumping.

A Peculiar Condition of Operation.

Another application of polyphase motors, possibly more interesting than the one mentioned above, is that in the sugar refinery at Cambrai, France. In this plant the most troublesome machines to operate are the large centrifugal drying machines. These machines must be started and stopped quickly and frequently, while they run but for a short time at their normal speed.

Series and Compound Motors Not Thought Suitable.

Under these conditions, the engineers naturally turned first to series or compound motors; but although these motors have an excellent torque at the moment of starting, this torque decreases as the speed increases, while, on the contrary, the power developed by the motor should increase with the increase in speed if a constant acceleration is to be given to the machine. As the kinetic energy of the centrifugal, which represents at any moment practically the sum of all the work done by the motor up to that instant, varies as the square of the speed, the energy stored up in it during the first few seconds in which the speed is brought up to 100 revolutions per minute, and at which the torque of the series motor is greatest, is negligible compared with that which must be given to the machine during the last few seconds in which the speed is increased from 900 to 1,000 revolutions per minute.

The Application of Induction Motors.

To meet this requirement the engineers decided upon a polyphase induction motor having a double winding on the rotor, and brought up to speed by connecting it to circuits supplying currents of different frequencies. The double winding of the rotor consists of a high-resistance circuit slightly embedded in the core, and a low-resistance winding deeply embedded. The former gives a large torque at starting, the latter a large torque as the machine nears normal speed. The combination gives a fairly flat torque characteristic. When starting, the motor is first connected to a circuit supplied with current at a frequency of twenty-one cycles per second. After speeding up it is connected to a circuit of which the frequency is thirty-five cycles, and finally to a circuit of which the frequency is fifty. In this way the machine is brought up to full speed in about one minute, while the energy supplied to it during this time by the driving motor, which is rated at thirty-five horse-power, is 110,000 kilogramme-metres, a performance which the engineers did not think they could obtain from a direct-current motor.

Motors Used in Braking.

Another advantage gained by the use of the three frequencies is that, by throwing the motor, which is running at full speed, successively on to the circuits having a lower frequency, the motor is made to operate as a generator, and in this way the machine is brought to rest in fifteen seconds, and returns to the circuit during this time much of the kinetic energy which would otherwise be dissipated in braking. The arrangement adopted was an ingenious solution of a difficult problem in machine driving.

DAMAGE TO SHADE TREES FROM ELECTRICAL CONDUCTORS.

A bulletin issued recently by the Massachusetts Agricultural College gives a somewhat detailed report of an investigation made to ascertain the damage caused to shade trees by stray electrical currents or by overhead wires of any kind.

Damage Due to Careless Trimming.

A good deal of damage to shade trees is not caused directly by the wires, but is done to make a clear way for them. In running wires, either for telephone, telegraph or railway systems, it is very important that there should be a clear way. For this reason it is usual for the linemen who are putting up the wire to trim those trees that interfere, and it is needless to say, that either through ignorance or carelessness, the work is done without much consideration for the trees. Probably in the greater number of instances this trimming does little harm, but it would be only just to have this work done as carefully as possible and to paint the wounds with some antiseptic so as to prevent the attacks of insects or disease.

Young trees standing under a pole line are apt to be injured if this line carries a large number of wires, as the buds on the upper branches are killed by rubbing and striking against the wires. This produces a distorted and stunted growth.

Injury from Alternating Currents.

The effect of currents leaking from wires to the ground through trees does not seem to be well understood. The report considers damage due to both alternating and direct currents, and it says that no case has been reported where an alternating current has killed the entire tree. The damage due to alternating currents usually consists of a burning at the point of contact of limb and wire. If this burning is severe it is apt to kill the entire limb, but the passage of the current through the lower part of the tree does not seem to be injurious. From laboratory studies it was found that very small currents do not affect the tree at all. Then there is a range of current intensity which stimulates. A further increase in intensity of the current produces retardation, and finally a value is reached which kills the plant. These experiments were carried out on small plants, and followed by measurements of the resistance of trees which were made to determine what danger there was of stray currents reaching an intensity sufficient to retard growth or to kill the tree. The values found were high and while the measurements were crude and can hardly be thought to give more than an indication of the resistance of a tree trunk, they show that there is little danger of death from a current leaking from an alternating-current feeder. The actual cause of the death of the small plants seemed to have been the heat pro-

duced by the passage of the current, and was not due to any electrical effect.

Direct-Current Injuries.

Direct currents, however, are not as free from blame as the alternating. While the usual damage due to a direct current is a more or less severe burning at the point of contact, whether the damage extends further seems to depend upon the direction of the current flow through the trees. The circuits usually causing trouble are the railway feeders which carry a potential of about 600 volts and have a grounded return. Where, as is usually the case, the line is positive and the ground negative, no case was reported of the death of the entire tree, the damage being similar to that caused by alternating currents; but in a few cases, where the feeders were negative and the ground positive, the entire tree was killed. There was a burning at the point of contact and, lower down, the vital layer between the outer bark and the wood was killed entirely around the trunk. That this effect was due to the direction of current flow would seem to need verification, for, while reasons may be suggested for the difference in the action of the currents when flowing up or down the trunk, these are merely speculations. Electrical endosmose may take place and effect the flow of sap, or a migration of positive ions, of such salts as are in solution in the earth, into the roots may produce poisoning, while a similar action of negative ions may have no deleterious effect. A further study of the action of direct currents on trees would be interesting and should be made, and if the effect mentioned in the report is confirmed, the remedy is obviously to reverse the polarity of the electrical system.

Lightning.

The effect of lightning on trees is also taken up in the report. It is said that only in a small number of instances where a tree is struck is it killed. In general the discharge takes place without damage, or merely producing a vertical groove in the trunk which heals up. If, however, the discharge follow a spiral path to the ground it may more or less completely circle the tree, and in this way kill it. An effect which is sometimes noticed, but which was not mentioned in the report, is a loosening of the bark as though it were forced out by the formation of steam in the vital layer. Instances have come to our notice where trees have been killed by lightning, although the grooves caused did not circle the trunk, but where large sections of the bark were loosened apparently in this way.

SPEED OF X-RAYS DETERMINED BY M. BLONDLOT.

BY C. L. DURAND.

An interesting series of researches has been carried out by M. R. Blondlot in order to determine the speed of the X-rays and find out whether their velocity is comparable with that of the electromagnetic waves or with light. He seems to have been successful in establishing that the X-rays are propagated with the same velocity as those of light. This he proves by a very ingenious method. The poles BB′ of an induction coil (Fig. 1) have two wires connected to the poles HH′ of a focus tube which produces the X-rays. Before reaching the tube the wires, which are horizontal and parallel, are connected to the two halves of a Hertz oscillator formed of two brass cylinders AA, three inches long, placed horizontally in a tube containing oil (not shown). Below the tube is a resonator formed of a loop of copper wire DD *c*; the straight part lies just below the oscillator (it is here shown at the side, for clearness). The spark-gap C is turned toward the focus tube so as to receive the X-rays; it is protected from all other radiation by black paper and aluminum foil. By regulating the striking distance of the oscillator he succeeds in making the focus tube and the oscillator to work at the same time. At each current-break of the induction coil the difference of potential between H and H′ rises to a sufficient value to operate the tube, then as it continues to increase it causes a spark in the oscillator; the tube, suddenly deprived of its supply, is extinguished, while the oscillatory discharge of the cylinders goes on and finishes. In the first case the tube is near the oscillator and the wires AH, A′H′ are as short as possible (eleven centimetres). Place as abscissæ (Fig. 2) the time values, starting at the moment when the spark of the oscillator occurs, and as ordinates the differences of potential at AA′. Then we have, as is well known,

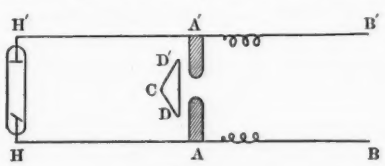


FIG. 1.

the sine curve MNPQ of the oscillatory discharge, which dies away rapidly. Once the apparatus is regulated, the potential necessary to work the tube is but little below the striking potential of the oscillator, and it suffices to diminish slightly the distance between the cylinders in order to cause all the discharge to pass by the oscillator and none by the tube. This fact is of capital importance here, and it results that the tube is extinguished when the potential is diminished slightly at the start of the oscillatory discharge, and this occurs at the end of a certain time below a quarter period of the discharge wave. The curve representing the intensity of the X-rays is therefore nearly horizontal (RS) before the discharge of the oscillator commences, followed by a quickly descending part SU.[1] By making a new curve III having as ordinates the values of the electric force produced at spark-gap by the discharge of the oscillator, the ordinate of this curve is zero, while all the discharge passes by the focus tube and thus up to the O point of the time curve; it only reaches appreciable value when the oscillator is partly discharged, and the maximum of the electric force only occurs when the oscillator is recharged in the contrary sense, or at the end of half a period. This duration is represented by OZ. It follows that when the resonator commences to oscillate the X-ray tube is already extinguished. Therefore there can be no action of the tube upon the secondary spark of the resonating loop. Experiment verifies this, for if a lead plate is placed so as to cut off the X-rays, the spark does not change its aspects, which it would do had it been previously exposed to the rays.

Leaving the focus tube in the same place the short wires AH are replaced by wires twenty-five centimetres long, folded up without angles. The length of the wire, by retarding the extinction of the tube by that length of time needed for

[1] The length of the oscillator wave is found to be 1.14 metres; its period is $\frac{114}{3 \times 10^{10}}$ seconds, and therefore OU is much less than $\frac{114}{3 \times 10^{10} \times 4}$ seconds.

the Hertz waves to travel over 25 — 11 centimetres or fourteen centimetres; will be sufficient to delay by so much the disappearance of the X-rays at the place of the resonator spark, and give them more time to act upon this spark. This is found to be true, for the interposition of the lead screen causes the spark to become less brilliant, contrary to the former case, showing that the rays now act upon the spark. This effect of the X-rays is increased when the wires AH are lengthened to 33, 80, and 130 centimetres. The folded wires are now taken with a fixed length of fifty centimetres, then the tube is gradually removed from the resonator. By this the X-rays are retarded by the extra time taken to cover the increased distance; their disappearance at the resonator is thus retarded, and if their speed is comparable to that of the Hertz waves the effect of removing the tube to a distance will be analogous to the effect of using the longer wires, that is, it will be more favorable for the coincidence of the spark at the gap and the period when the X-rays are present there, and will thus give an increased action of the rays on the spark. We are thus brought to the paradoxical conclusion that the tube should act better upon the spark when far off than when near-by. To our surprise, the experiment succeeds completely. The brightness of the spark is increased when the tube is farther away, and this fact is certain and constant. This variation is beyond doubt due to the X-rays, for with a lead screen placed between, the spark becomes weaker and then remains invariable, regardless of the distance of the tube. This rather surprising fact is the first verification of the original idea that the speed of the X-rays is comparable to that of the Hertz rays or of light.

Taking a wire eighty centimetres long, for instance, when the tube is placed farther off it is observed that for a certain distance the X-rays have their full effect on the spark during all the time that the electric force at the gap keeps up a notable value (Fig. 3), and thus the effect of the rays is as great as their intensity will allow. When the tube is still farther removed, the effect should not be increased and the X-rays will lose their intensity more and more; therefore the action passes by a maximum. Experiment proves this, as when the tube is fifty-three centimetres from the gap the effect of the X-rays disappears (as shown by the lead plate). Thus the supposition that the speed of the X-rays is comparable to that of light leads us to predict a maximum point, and this is verified by experiment.

In a second series of researches the proof is still more conclusive. Resuming the same apparatus, with a wire eighty centimetres long. The maximum brightness of the spark occurs when the tube is fifty-three centimetres from the gap. Let V and V′ represent the respective speeds of propagation of the Hertz waves and the X-rays in centimetres per second. After finding the position of the tube

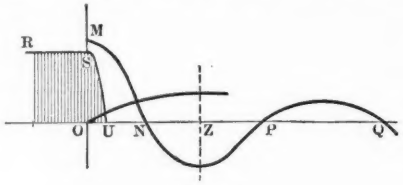


Fig. 2.

which gives a maximum spark, we now lengthen the wire by α centimetres; the cessation of the spark at the resonator is therefore retarded by $\frac{\alpha}{V}$ seconds. We must therefore, in order to reestablish the coincidence of the time and find the maximum, diminish the distance from the tube to the spark by a certain value β, such that $\frac{\beta}{V'} = \frac{\alpha}{V}$. Experiment gives us the value $\frac{\beta}{\alpha}$, and therefore in virtue of the preceding equation we have $\frac{V}{V'}$. By using a series of positions, in which α is made to vary within wide limits, it is found that $\beta = \alpha$, whence it results that $V = V'$. The author gives a table of values to show this and the experiments show a close approximation.

Another experiment is the following. In this case we still compensate the time needed for the X-rays to clear a certain space by the time required for the Hertz

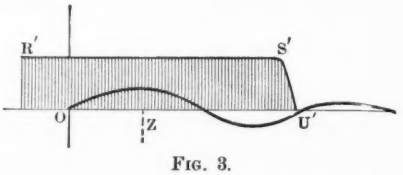


Fig. 3.

waves to travel over a given length of wire, but here it is not the transmitting wire which is changed in length, but the resonating wire itself. The ends of the resonator are separated by 0.3 centimetre and are soldered each to the two wires of a small transmission line. At the end of the line is placed a spark micrometer. The new spark-gap is brought into the position of the old by winding the small line upon itself. The action of the exciter on the resonator produces an oscillatory wave, which must pass over a certain length of wire to reach the gap and produce the spark. If, therefore, each half of the resonator is lengthened by a centimetres, the spark is retarded by $\frac{a}{V}$ seconds, and to obtain the maximum spark the distance from the X-ray tube to the gap must be increased by a certain distance b centimetres, such that $\frac{b}{V'} = \frac{a}{V}$. The observed value of $\frac{b}{a}$ gives that of $\frac{V}{V'}$. Experiment showed that when a was varied between O and twenty-five centimetres the value of $\frac{V}{V'}$ remained practically constant at 0.93. This method serves therefore to verify the preceding results which gave 0.97; besides, the preceding method is more accurate. By the foregoing two methods used to determine the ratio of the speeds, one gives 0.97 and the other 0.93. From these different experiments, which were carried out with great care, the author concludes that the speed of propagation of X-rays is equal to that of light.

New York Section of the American Electrochemical Society.

A meeting of New York members of the American Electrochemical Society was held at the Chemists' Club, New York city, Saturday, October 10, to consider the advisability of organizing a New York section. Owing to the bad weather, the attendance was small, but a number of those who could not attend communicated by letter or telephone. It was decided to ask for authority to organize the section and that it should be governed by a council of five. Dr. Charles A. Doremus was made chairman and Mr. Alois von Isakovics, secretary. The other three members will be appointed by the chairman.

Electricity on War Vessels.

The application of electrically operated apparatus aboard war vessels has been so extensive that practically every kind of service is now electrically performed, with the exception of the operation of the steering gear, main engine, pumps, ash-hoisting machinery and forced draft blowers. There appears to be nothing about the latter named devices that would prevent their being electrically operated. The electrical steering gear, it is asserted, is now under an experimental trial. A very interesting feature about this apparatus is that it may do away with the time-honored wheel, and a controller and handle similar to that used on an electric car be substituted for the same. The ships' boats are now handled by cranes, which are electrically operated, so that prompt and easy shipping and unshipping of boats and launches can be effected.

ON SINGLE-PHASE REPULSION MOTORS.[1]

BY WILLIAM CRAMP.

It is a matter of common knowledge that if it were possible to construct a single-phase alternating-current motor having the characteristics of a direct-current series motor, and no serious drawback, it would find a very extensive application, on account of its extreme suitability for the transmission of power, especially in connection with railway work on long lines. There are many forms of single-phase induction motor on the market, some of which are, for certain purposes, very useful. Yet in spite of these, the single-phase motor is avoided wherever possible, as is clear from the many costly alterations which are being carried out in this country. It is only necessary to mention a few examples of this. In Croydon a direct-current plant has been laid down for the centre of the town, solely to provide for motors, in addition to the already existing alternating supply. The City of London Electric Lighting Company is slowly replacing alternating by direct current, for similar reasons. The towns of Coventry and Sheffield are introducing two-phase in place of the existing single-phase system. No doubt, much of this will be changed if the Baltimore & Annapolis Railway is successful, since that will demonstrate the existence of single-phase motors comparable to the direct-current series motor, and the extreme simplicity and flexibility of the single-phase system will again recommend its adoption in cases where three-phase plant is now in contemplation.

At present there is a choice of three types of motors on single-phase systems.

1. The Synchronous Motor—The disadvantages of this form, where starting and stopping is frequently necessary, are sufficiently obvious.

2. The Asynchronous Induction Motor—The disadvantages of this motor are that special devices, always cumbrous and often very expensive, must be employed to start it up, and even then a current usually considerably in excess of the full-load current is needed to run it up to speed under load—often a grave objection on lighting circuits. Moreover, even under favorable conditions, the power-factor is poor, the efficiency not high, the possibilities of varying the speed almost nil.

3. The Series Alternate-Current Motor—This motor bids fair to rival the previous forms for general application, and will, as we have said, be thoroughly tested on the Baltimore & Annapolis Railway. Its disadvantages are that the frequency at which it is most successful is very low, thus rendering it inadmissible on lighting circuits, while its power-factor tends to decrease with load, and pressure difficulties at the commutators are almost unavoidable.

The only other type at present practicable is the repulsion motor. For several years past I have been working to

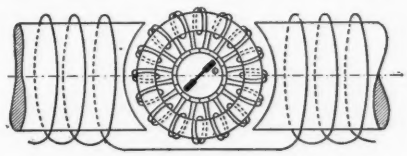


Fig. 1.

ascertain the lines on which really efficient and satisfactory motors of this type might be designed, and I now believe that repulsion motors may be built, up to at least twenty horse-power, which will compare favorably with any type of motor at present in use. In its simplest form the repulsion motor consists of a laminated electromagnet or stator excited from the single-phase mains, and an armature or rotor wound almost exactly like the armature of a direct-current machine, and fitted with a similar commutator. Brushes rubbing on this commutator are set at a particular angle and short-circuited. The alternating flux set up by the stator induces in the coils of the rotor currents in such directions that the coils carrying them tend to move out of the inducing field. The action is exactly the same as that shown by Professor Elihu Thomson to exist when a plain copper ring is brought into the field of a solenoid excited by an alternating current.

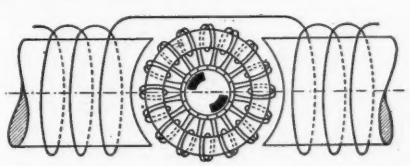


Fig. 2.

Figs. 1 and 2 show clearly the two main forms of repulsion motor. In Fig. 1 the angle θ is usually forty-five degrees or less. This type has the following peculiarities: (*a*) the electromotive force of a quarter of the rotor opposes that of the other three-quarters, leaving half the rotor for useful electromotive force; (*b*) the rotor current passes through all the coils, whether in a useful position or not, thereby increasing the C^2R loss; (*c*) a quarter of the rotor gives a torque opposing rotation; (*d*) individual coils short-circuited by the brushes are constantly giving a torque opposed to rotation, and causing difficulties with commutation. These disadvantages led me to construct repulsion motors on the lines of Fig. 2; and it is partly due to the adoption of this form that I have succeeded in obtaining satisfactory commutation. The difficulties of construction, chief among which is commutation, have led most writers to speak of repulsion motors with much distrust. Thus Elihu Thomson, whose patent of 1889 covers the whole principle of repulsion motors, refers to them as capable of giving out considerable power, "though with what economy is unknown." Professor Jackson condemns them as "bulky, expensive and inefficient," though he adduces no evidence in favor of this verdict. Mr. Steinmetz writes "they have the disadvantage of using only part of the rotor," but as recently as December, 1902, he said that he believed better results were to be obtained from them than from series alternate motors. To show how very misleading are these statements, I here add: (1) That Mr. Hobart proposes using only fifty per cent of the armature for his recent direct-current machines. (2) If the coils of the rotor are only half of them used at any given instant, it is obviously possible to work at a higher current density. In one of my experimental motors I have had eight amperes through No. 21 wire without serious heating. (3) In such alternators as the Mordey-Victoria, only half the armature is ever really active at one time.

The chief difficulties in the construction of repulsion motors are: (1) liability to vicious sparking and (2) difficulty in obtaining a high power-factor. In the first form of repulsion motor which I tried I found that the spark was almost as great on closing the coil as on opening it. In order to investigate this, I had some experiments carried out on the opening and closing of circuits, of which I now relate briefly the results. With an inductive circuit there was less tendency to spark on the make than with a non-inductive circuit, and there was much less tendency to spark on the make with copper than with carbon contacts. I find, on the whole, that to avoid sparking on the make, a good, firm, clean, low-resistance contact is adequate. For this reason I have so far used copper brushes in the motor, but, despite this, the choice between carbon or copper has to be decided by the consideration of the whole of the circumstances, which would be too long to discuss now. With copper brushes I have been able to get absolutely sparkless

[1] Paper read before the British Association, Southport meeting, September 9-16.

commutation, working from nothing to full load, on a motor whose design was in other respects distinctly faulty. These results refer more particularly to motors of the class represented by Fig. 2, whose only disadvantage is the long arc of brush contact, entailing corresponding friction. Having by copper brushes provided for closing the circuit sparklessly, I was enabled to obtain sparkless opening by means of the same principles that are employed in what is known as "resistance commutation"—that is, providing a sufficient interpolar space to enable each rotor coil to pass entirely outside the magnetic field, so that the current can die down before the opening of the circuit. It is obvious that a form of commutation might be employed corresponding to what in dynamo design I call "electromotive force commutation" (a term which explains itself); or, better still, a combination of electromotive force and resistance commutation, and as the output of the motor undoubtedly increases with pole width, it might pay to use one of these modifications, on which point, indeed, I am at present experimenting. In considering the actual design of a repulsion motor, the first object is to decide which form of commutation you are going to rely upon. Having settled this, the form of stator is practically fixed, for if resistance commutation is to be relied on entirely, the stator must have distinct poles—by this I mean that there must be considerable air space left between one polar winding and the next, as in the direct-current machine. On the other hand, if electromotive force commutation be used, the stator may be built exactly like that of an ordinary single-phase motor. I have tried both forms, and find that while both may be rendered sparkless between certain limits, the former gives good commutation over a wider range, while the latter gives better starting torque and better power-factor. But I would insist on the fact that every form of repulsion motor may be rendered sparkless if the design of the rotor winding is properly considered. Thus, what has been hitherto the great disadvantage of the repulsion motor disappears.

We therefore proceed to consider the design of the rotor winding. We may choose an arrangement such as that in Fig. 1, or a modification of Fig. 2. The salient differences between these two forms are: (1) in Fig. 1 all the short-circuited coils are in series, while in Fig. 2 they are in parallel; (2) in Fig. 1 the rotor current always passes through the whole of the rotor coils, whether active or useless; in Fig. 2 this is obviously not the case. If the rotor winding has to carry a large current, Fig. 2 is not very suitable on account of the fact of the large heating that takes place at the commutator, and the large proportion which brush resistance bears to the resistance of the coil lying between any given pair of segments. I have already stated, under the head of "commutation," other reasons for selecting windings of the type of Fig.

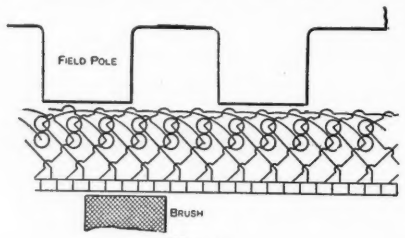


FIG. 3.

2, but I ought to add that recent experiments with windings of the type of Fig. 1 impress me very favorably, and all motors at present under construction are of this type. In actual experiment with windings like Fig. 2, I have found that if the rotor is of the closed-coil type, as shown, besides those coils actually short-circuited, there are other closed circuits carrying useless or even harmful currents. Hence, in the particular motor on which most of these experiments were made, the winding has been altered to that of Fig. 3, thus practically converting the rotor into an open-coil armature, with two coils in parallel.

These considerations determine the type of rotor winding, and we now pass to the discussion of the electromotive force, current, torque, etc., taking first the case of a bipolar motor with a single coil, as in Fig. 4A. This diagram is really a simple case of Fig. 2. If the pole arc is fifty per cent of the pole-pitch, and equal to the width of the coil, and the distribution of magnetic flux radially around this pole arc is sinusoidal, then the electromotive force set up in the coil is a pure sine wave. If, however, the flux is distributed uniformly radially over the pole arc (as is more probably in an actual machine), the lines enclosed by the coil when the field is constant are as represented in Fig. 4B. This is a sine wave with some odd harmonics which are of small importance in the present case; the third harmonic, which is the largest, has an amplitude of only one-ninth, the fundamental. I shall assume, then, for present purposes, that both the time variation of the main flux and the time variation of the area of the coil with respect to the total flux are both sine functions. We then have, if number of turns on the stator winding $= t_1$, number of active turns on the rotor $= t_2$, maximum magnetic flux per pole $=$ F, speed of motor in revolutions per second $= n$, periodicity of stator current in periods per second $= f$, R.M.S. primary E.M.F. $= e_1$, R.M.S. secondary E.M.F. $= e_2$. Then it is found that

$$e_2 = \frac{e_1}{\sqrt{2}} \quad \frac{t_2}{t_1}\sqrt{1+\left(\frac{n}{f}\right)^2}$$

which means that the secondary electromotive force may be represented by the resultant of two lines at right angles, as shown in the phase diagram (Fig. 5).

Passing on to the equations for current, we have, upon closing the circuit when one side of the coil is just coming into the field, a current made up of two terms—(A) the exponential term, (B) the ordinary sine wave. The term (A), which may usually be neglected in other alternating-current apparatus, is often, in the case of the repulsion motor, of great importance. It is extremely difficult to show the value of this term in any phase diagram, but its general effect is to shift the rotor current slightly forward in phase, and to cause the torque of the rotor to sink to zero at a lower speed. The cases in which it is of greatest importance are those of the type of Fig. 2, in which the number of turns per coil is large. I found its effects to be very strongly marked in the first two motors I made; but I do not anticipate that in

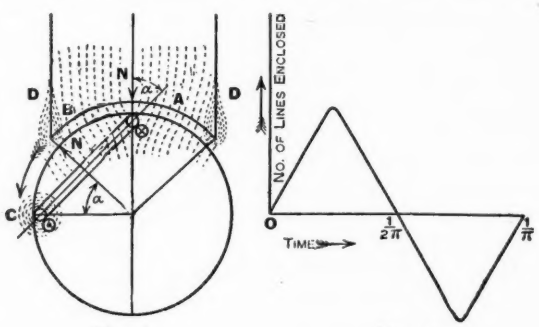


FIG. 4A. FIG. 4B.

future designs its effect will be so marked, for two reasons: first, because I now aim at few turns per rotor coil; and, secondly, because I use a greater number of commutator segments. Coming now to term (B), I think it is easier to consider the action of the motor from the standpoint of the Heyland diagram. In Fig. 6 we have a representation of the transformer diagram. Figs. 4 and 6 are lettered alike. S is the stator, R the rotor. Let the flux at TT be represented by OF (Fig. 5).

Now, we may resolve the field OF in two directions in space—*viz.*, along the line of the brushes and at right angles thereto. FD and DO will represent these components, the point D lying upon a semi-circle, as shown. The angle DFO is that corresponding to λ in Fig. 4. DF now represents the field which vibrates through the rotor coil, and DE, at right angles and proportional to it, must represent in time the electromotive force generated in the rotor coils. (It is better to keep time and space separate by arranging all quantities in phase in time in one plane. Thus DE would be drawn in a plane at right angles to that containing DFO, as is done in the author's model.) The electromotive force, DE, may be resolved into two components at right angles in time DG, GE. Of these two, GD is proportional to the CR drop in the rotor coil and hence to scale (with constant rotor resistance) represents the magnitude and phase of the rotor current. GE represents that component of the rotor current tending to demagnetize the stator. The angle ϕ_2 is the angle of lag of the secondary or rotor current. As ϕ_2 increases, the rotor CR drop DG decreases and the rotor demagnetizing component increases till EG = ED, when the rotor current is zero and the field FD is balanced. Now, since DE is proportional to DF, it may be drawn of the same length. Then the semi-circle DGE may be applied to the line DF, so that E falls on FDG, and EG becomes FG^1, and shows the way in which DF becomes gradually balanced. The angle G^1DF then = GDE = ϕ_2. Now, the component of DG in phase with DF or DO is the projection if DG on DF = DC = DG sin ϕ_2. The component multiplied by DO is proportional to the torque of the motor—*i. e.*, the torque varies as the area of the triangle DCO.

We have rotor current $\propto$ DG $\propto$ DE cos ϕ_2;

DE $\propto$ DF = OF cos OFD = OF cos λ;

DO = FO sin λ;

DC = DG sin ϕ_2.

Hence torque at starting = DC $\times$ DO;

= DE sin ϕ_2 cos ϕ_2 $\times$ OF sin λ;

= OF . OF . sin ϕ_2 cos ϕ_2 sin λ cos λ;

which is a maximum when

$$\left.\begin{matrix}\sin\lambda = \cos\lambda \\ \sin\phi_2 = \cos\phi_2\end{matrix}\right\} = \frac{1}{\sqrt{2}} — i.e.,$$

when a and ϕ_2 = forty-five degrees.

Now, OF $\propto$ primary voltage (nearly). Hence the starting torque is proportional to OF^2 — *i.e.*, to the primary voltage.

These are the starting conditions.

Running Conditions—Directly the starting torque is large enough the rotor

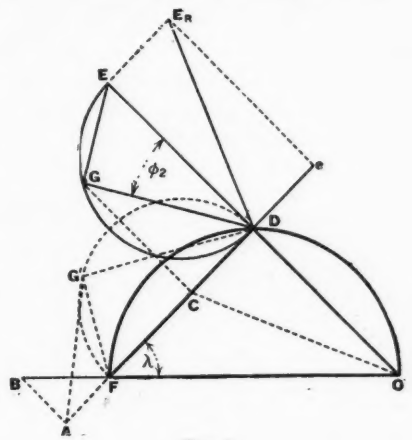


FIG. 5.

begins to revolve, the coil F (Fig. 4) tending to set itself so that it encloses a minimum of the magnetic lines issuing from the stator. Thus motion takes place in the direction of the arrow in Fig. 4; and this must be due to the fact that the current sets up a field in the rotor coils which is on the whole of opposing—*i. e.*, identical—polarity to that existing in the stator. Thus, if at a particular instant (in Fig. 4) the polarity of the stator

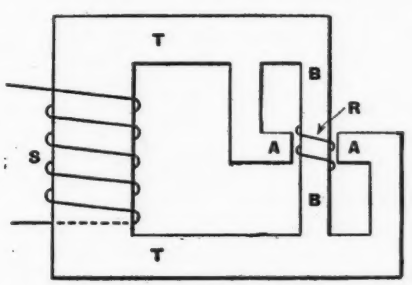


FIG. 6.

is north, as marked, the polarity of the rotor field, due to the lagging rotor current, must at the same instant be north. At this particular instant the lagging rotor current must be in the direction shown by the cross (+) and dot in Fig. 4. By Lenz's law the electromotive force set up by rotation must oppose this current. Therefore, directly the rotor begins to revolve, the rotor lagging current is reduced, or, in other words, the coefficient of self-induction of the rotor coil is virtually diminished. Suppose, now, the rotor is running, then the coil shown in Fig. 4, immediately it moves, would have its place taken by the one next it, and thus, although the rotor revolves, we may, as it were, speak of an "equivalent stationary coil," whose axis is settled by the diameter upon which the brushes are set. Considering now the coil shown in Fig. 4 as representing this equivalent stationary coil, we see that its coefficient of self-induction may be altered to a certain extent by moving it round in the direction of rotation. In this way, however, much the phase of the rotor current may be altered by the electromotive force due to rotation, the original conditions may be reproduced by moving the brushes in the direction of rotation. Theoretically, this may be carried on till the axis of the coil is at right angles to the axis of the field, when the speed of the rotor is infinite. Naturally, in practice there is a limit, depending upon the particular form of stator and the torque necessary to overcome the friction of the rotor bearings, etc.

In order to show this electromotive force due to rotation in Fig. 5, we remember that it is really produced by the field DO, and, therefore, will be at right angles to DO in space. Thus it may be represented by D e, and its effect is obviously to reduce the secondary lagging current, thus reducing the primary lagging component and the total primary current. With increasing speed, then, the point g will tend to travel along its semi-circle. The value of the component

$$DE = \frac{e^1}{\sqrt{2}} \frac{t_2}{t_1}, \text{ while D } e =$$

$$\frac{e^1}{\sqrt{2}} \frac{t_2}{t_1} \cdot \frac{n}{f}.$$

Thus at synchronism D e = DE, and if the motor started with maximum torque the point g will have arrived at E, when the motor arrives at synchronous speed.

The above results are only approximately correct, for the following reasons. We have assumed conditions of constant field which do not exist exactly in ordinary conditions. Again, we have assumed that the current-conductor distribution around the rotor is sinusoidal, which is not true, and that the number of conductors acted upon by the field DO is the same as that under the influence of the field DF. Later I hope to have an opportunity of showing how each of these peculiarities affects the phase diagrams already given. For the present it is important to note that the machine will gen-

erate if revolved in the direction opposite to the arrow in Fig. 4.

Since the law of the diagram is so simple, a model may easily be constructed, ruled by the fact that OF is of constant length, and the point D moves along a semi-circle. From this model the values of primary and secondary current, torque, and power-factor may readily be deduced, and the following peculiarities may be noted:

1. The torque depends on the relative phases of stator and rotor currents, and at starting it is a maximum when the power-factor is about sixty per cent. At any speed the torque will always be a maximum with about this power-factor, but in order to keep this maximum torque the brushes would have to be gradually moved in the direction of rotation as the speed rose. In the case of small motors, I should say that there is no reason at all why the brushes should not be moved forward, either automatically or by hand in this way, since, as already shown, sparking difficulties may be completely overcome.

2. Power-Factor—If maximum torque is required of the motor at starting, and the brushes are to be kept fixed, it follows that the power-factor can never exceed seventy per cent. This at first sight appears a serious drawback, but in actual practice there are many cases where it will be no disadvantage at all. Take, for instance, a small printing establishment, or a tramway system of no great length. The disadvantages of the lagging current are twofold: (1) C^2R loss in the line—of small importance, as we have supposed the line short; (2) reduction of the voltage at the generating station by reaction upon the alternator fields, which is clearly counterbalanced by the fact that the power-factor of such motors is a maximum at starting and gradually decreases as the stator current decreases while running. Thus the actual value of the lagging current will not vary very seriously, and, so far as the engineer at the central station is concerned, should cause no trouble. In fact, the motor is in this respect in as good a position as a polyphase motor started with resistance in its rotor circuit, and in a far better position than any ordinary single-phase induction motor. In the case of large motors or long transmission lines, the power-factor of the motor with maximum torque at high speeds may be very materially increased. Perhaps the best way of doing this is by means of slip-rings attached to the rotor windings, just as if it were a rotary converter. Resistances inserted between these slip-rings are gradually cut out as the speed rises, so that the motor finally acts as an induction motor, a device of mine incorporated in a repulsion motor arranged at the Central Technical College three years ago, and which I see from an article by Herr Schüler in the *Electrical Engineer* of September 4 has recently been the subject of an English patent.

3. Efficiency—In any class of electromotor this is bound to depend largely on the amount of material put into it. Comparison is, therefore, admissible between motors of different types and of the same weight. In this connection my present experience does not enable me to give any definite figures, but I should say that the repulsion motor for a given power will be heavier than the corresponding polyphase motor, and lighter than the single-phase motor with its starting apparatus. Considering the enormous waste of energy in starting the latter, the repulsion motor will be far more economical for non-continuous running. Unfortunately detailed results of actual output per kilowatt during continuous running are not yet forthcoming from any source.

4. Starting Advantages—Under the best circumstances the repulsion motor may be started under full load with a current only slightly exceeding the full running current. This great advantage is obtained without any expensive and cumbersome starting arrangement, and it is this which must be put forward as the great advantage of this type of motor. Of course at starting the motor is really a special case of the split-phase type of motor, and the only reason why it is so much better than other motors depending on this principle, is that the phase splitting is performed by the motor itself, and depends on no additional apparatus. Further, by careful design the phase difference produced at starting must be so very much greater here than in any starting apparatus for single-phase motors, except such as depend on the introduction of a very large condenser.

This paper must, of course, be considered as preliminary, in that no curves of results are given, but these I hope to have ready to publish shortly.

Memorial to James Watt.

A movement is in progress in England to erect a memorial to James Watt. At a recent meeting of those interested in the project it was decided that the form the memorial should take should be an institution for scientific research, and an appeal is now being made for funds to carry out this plan. Mr. Andrew Carnegie, who is the secretary for America, has promised a subscription of $50,000.

Electric Railways in the United States.

In the early part of 1888, it is asserted, only eighty-six miles of electric railways were in operation in the United States, using about 172 cars. The census report dated June 30, 1902, showed 22,589 miles of electric road, using 67,199 cars, and requiring 1,298,133 horse-power for their operation. The number of passengers carried during the year was nearly 6,000,000,000. The total gross earnings reported were $241,584,697, and the operating expenses were $139,012,004, leaving net earnings of $102,572,693. The total number of employés was 138,183, and the wages paid them amounted to $84,636,275, or an average of about $614 each per annum. The above length of line has now been increased to nearly 26,000 miles.

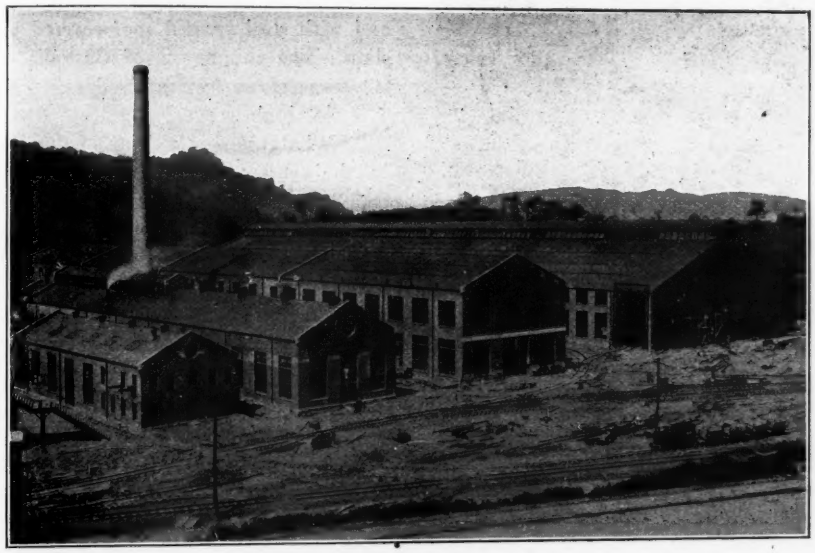
The original electric cars were usually old horse cars mounted on improved trucks carrying electric motors of about twenty-horse-power capacity, having a maximum speed of about twelve miles per hour. To-day we have not only city railways, but interurban railways, operating on private rights of way, carrying passengers, express and freight matter, equipped with cars that will run at a decided increased speed, and we find some of the electric roads now putting on sleeping cars nearly sixty feet long, each equipped with 600 horse-power in electric motors, and ten compartments, with upper and lower berths that fold up during the daytime, and so arranged that the cars can be converted into parlor cars having twenty chairs for the day service.

Journal De Chimie Physique.

The first number of the *Journal de Chimie Physique*, which is edited by M. Philippe A. Guye, has come to hand. This journal will publish articles in the field of electrochemistry, thermochemistry, radiochemistry and mechanical chemistry. The list of collaborators includes a number of distinguished names, among whom may be mentioned Arrhenius, Berthelot, Curie, Heroult, van't Hoff, Nernst, Ostwald and Ramsay. This issue contains an article by W. Longuinne and A. Schukareff, upon "A Thermal Study of Certain Alloys of Copper and Aluminum;" an article by P. Duhem, on "Binary Mixtures," and one by J. H. van't Hoff, on "The Law of Phases." Brief abstracts are also given of the important scientific papers published in other journals, together with a list of electrochemical patents. The journal will be published monthly from the main office in Geneva.

The New Plant of the Westinghouse Foundry Company at Trafford City, Pa.

THE Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company have projected a new industrial development at Trafford City, Pa., for the accommodation of their immense foundry interests. The old station for many years known as Stewart, on the main line of the Pennsylvania Railroad, seventeen miles east of Pittsburg, four miles from East Pittsburg, and about two and one-half miles from Wilmerding, Pa., was selected as the site for the new operations. The name "Trafford City" has been given to this in connection with the large interest of the Westinghouse Companies at Manchester, England, in a district known as Trafford Park. During the last four months a flourishing industrial centre has been developed as an accessory to several great manufacturing establishments located near-by. Comfortable and sanitary homes for the workmen employed in the operation of the new plant, and for others who administer to the needs of the new community, have been established. When it became apparent that additional foundry facilities would in the near future become imperative, owing to the increasing business of the Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company, the initial step in the projection of this movement was taken early in 1902. Some 600 acres of land have been secured by purchase for the Westinghouse Foundry Company, the Security Investment Company, of Pittsburg, a Westinghouse interest, being the medium employed to acquire it.



SHOWING FOUNDRY, PATTERN SHOP AND STORAGE, POWER-HOUSE AND BRASS FOUNDRY.

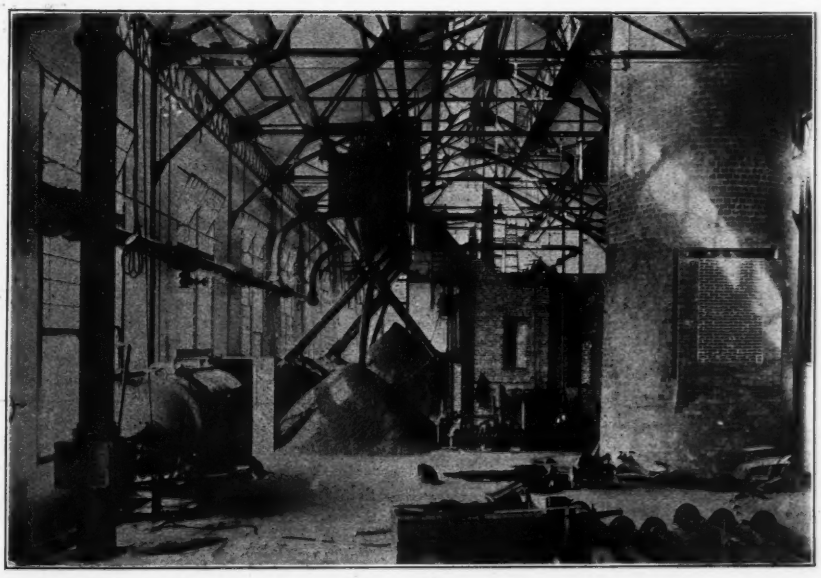
THE LOCALITY.

The contour of the land hereabouts, as everywhere in the neighborhood of Pittsburg, is hilly and rolling, with lateral streams draining the included watersheds and flowing into the Allegheny and Monongahela rivers.

One of these smaller water courses, known locally as Turtle creek, winds through the site of Trafford City, having in past ages, when it could boast of more majesty than it now possesses, worn down the land where it was softest and left it at this place with a slope composed of several terraced levels, and taking advantage of this natural arrangement, the Westinghouse Foundry Company has established its plant on the lowest level on the same grade as the main tracks of the Pennsylvania Railroad, which pass adjacent to the site and connect with it, thus obtaining convenient facilities for the importation of raw materials without unnecessary handling.

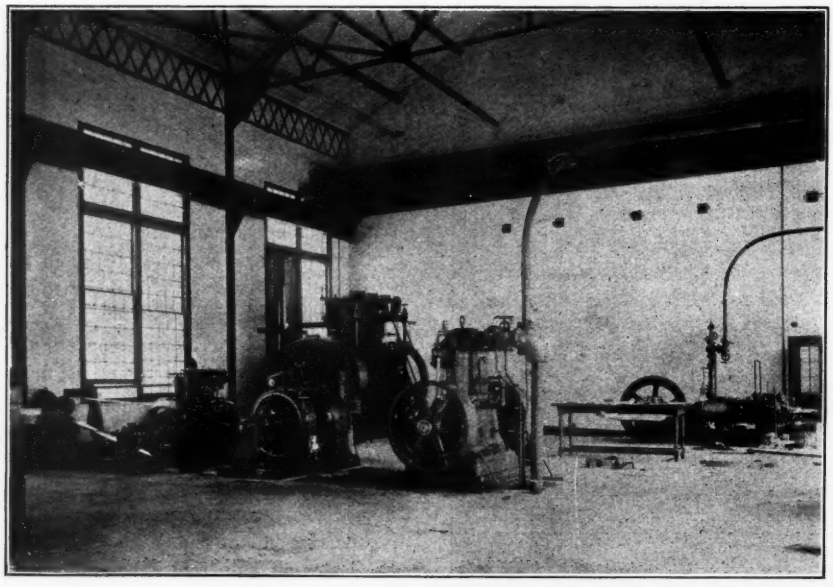
On the several terraces, rising in front of the foundry, yet shielded from its too obtrusive appearance by the ample foliage of large and handsome trees, lies the town proper, enjoying every natural advantage that can be desired, both from a sanitary standpoint and from the picturesque beauty of its surroundings. This locality is sufficiently remote from the manufacturing environs of Pittsburg to escape the pall of smoke which envelopes the latter, and on that account, if for no other, should be most inviting to the home-seeker.

The suburban train service of the Pennsylvania Railroad gives access to Stewart by a run of about forty minutes from the Union station in Pittsburg, and a still shorter run from the suburban stations of East Liberty, Wilkinsburg and Swissvale. The Pittsburg trolley system, by an approach over a steel viaduct 1,000 feet long, especially constructed for the purpose, makes its terminal by a loop through the city streets. Another trolley line enters the city from Greensburg, the county



POWER PLANT 1,000-HORSE-POWER BABCOCK & WILCOX BOILERS, EQUIPPED WITH RONEY STOKERS—BRICK STACK IN FOREGROUND.

seat of Westmoreland County, thirteen miles to the east, which, with its surrounding boroughs, claims a population of 25,000 inhabitants. Although actually a rural settlement, Trafford City is so accessible to the conveniences of the city that as a residence suburb there is little to be desired that is not already supplied.



Gas Engine Side of Power-House.

THE FOUNDRY SITE.

The site selected by the Westinghouse Foundry Company for its plant is formed by a bend of Turtle creek, in the shape of a reversed L, and consists of about 130 acres in area of level bottom land. Here is sufficient room to provide for the present foundry buildings, including the iron foundry, the brass foundry, the pattern shop, pattern building, and power-house, all of which are now completed, and afford room for the future construction of additional manufacturing plants equal to the combined capacity of all the plants now located in the Turtle creek valley.

RAILROAD CONNECTIONS AND FACILITIES FOR HANDLING MATERIALS.

The site is connected with the main line of the Pennsylvania Railroad by the Turtle creek valley branch, providing a link with the outside world as an inlet for supplies. As an outlet for product, a single-track railroad of standard gauge and of the very heaviest type of construction has been built connecting the foundry site with East Pittsburg, at which point the castings will be delivered for machine finishing at the plants of the Westinghouse Companies previously mentioned.

This road, built by the Westinghouse Companies and named the Westinghouse Interworks Railroad, intersects the town of Wilmerding, situated about half way between Trafford City and East Pittsburg, where the great works of the Westinghouse Air Brake Company are located, and are thus connected with the new industrial plant at Trafford City.

The terminal of this road at Trafford City has been amplified by a system of tracks connecting with the Pennsylvania Railroad. This terminal system comprises a railroad yard for storage purposes, connected by suitable switches and turnouts with each building and equipped with a system of overhead cranes for handling the heavy and bulky materials used in the operation of the plant. A narrow-gauge industrial railway, operated by ten-ton locomotives impelled by electric storage batteries, serves as an adjunct to the main system of railways in transporting about the yards and buildings the lighter and smaller supplies and accessories to the foundry service.

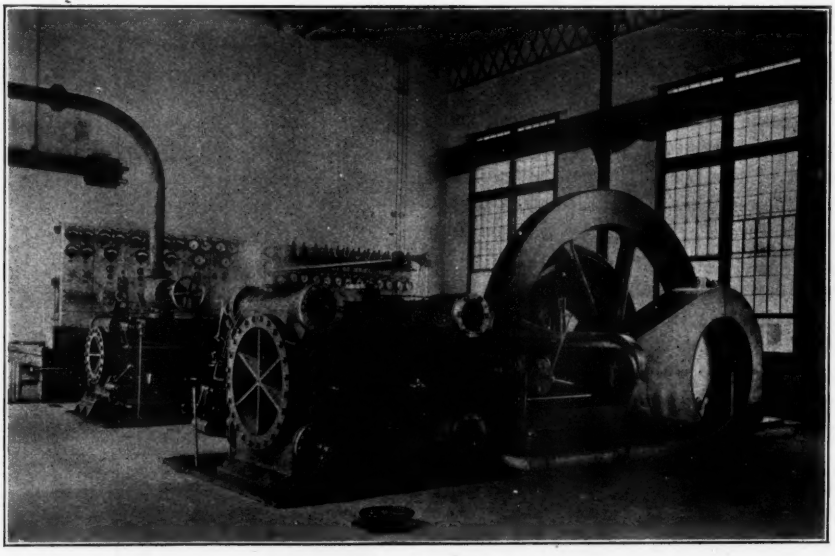
THE POWER-HOUSE.

The power-house, which includes under its roof a machine shop as well as a power plant, is 320 feet long by fifty-six feet wide. The building is of steel and brick construction, on concrete foundations, and with steel trussed roof covered with slate. The chimney is of Custodis construction, seven feet inside diameter and 175 feet high.

This building contains an engine room in the centre, with a boiler room immediately adjoining in the rear, the repair machine shop connecting at the front. At the rear of the boiler room is a pump room containing the fire service pumps and those for serving the hydraulic hoists, both of which are connected with the city water main and with a reservoir in Turtle creek, and back of this room is the locomotive room with provision for housing the two locomotives required for shifting purposes about the plant.

THE POWER PLANT.

The boiler plant at present consists of two 5,000-horse-power Babcock & Wilcox boilers, ample space remaining for the accommodation of double this equipment when the future growth of the foundry plant will require it. These are supplied with Roney automatic stokers operated by standard Westinghouse engines, and fuel in the shape of coal slack coming from local mines at the terminal of Turtle Creek Railroad is furnished to



Cross-Compound, Corliss Engine—Switchboard in Background—Engine without Lagging and Jackets.

them from steel hoppers overhead, to which it is carried by a "link belt" conveyor from a 100-ton storage pit outside of the building, into which the coal cars dump their contents while running over it.

The engine room is sufficiently large to accommodate two horizontal cross-compound Corliss steam engines of the Westinghouse type, having a capacity of 1,000 horse-power. One of these only is at present required and is already installed and coupled direct to a 600-kilowatt alternating-current, three-phase electric generator. A vertical gas engine of the Westinghouse type, having a capacity of 175 horse-power, is also in place and is direct-connected to a 120-kilowatt, alternating-current, direct-current generator. This engine draws its supply of gas from a well 1,900 feet deep, drilled on the property adjacent to the buildings.

The electric current from the steam-driven plant is used during the day for operating the cranes and other power motors about the foundry, and for such arc and incandescent lighting of buildings as may be necessary during the daytime. The current from the gas engine plant is used for such lighting and power as is required at night only. An underground tunnel, six feet square, thoroughly water-proofed, connects the power-house with the other buildings, and in this are installed all electric light and power conduits and the piping for steam, air and water.

THE MACHINE SHOP.

This room is equipped with lathes, planers, drill presses, and pipe threading and cutting tools, and such other appliances as would be required in the maintenance of a plant of this character. They are operated by an electric motor.

THE PATTERN SHOP AND STORAGE BUILDING.

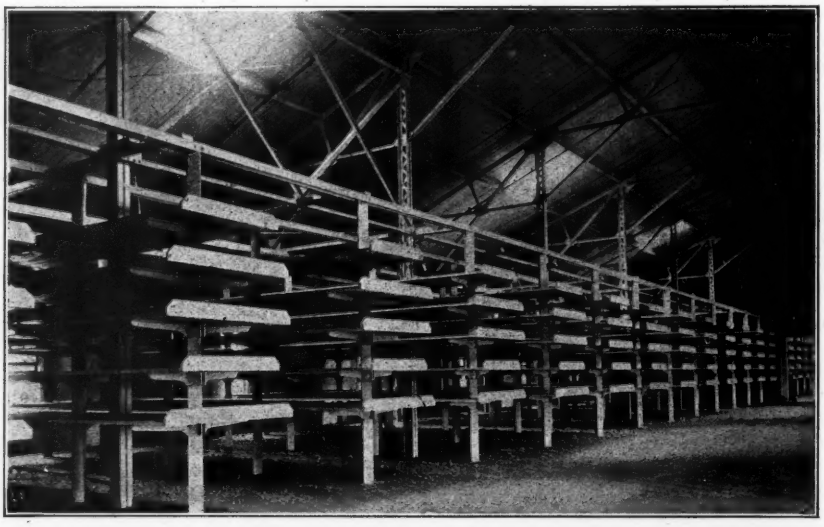
This building, located at the extreme southern portion of the site, is 603 feet long by eighty feet wide. The foundation is of concrete and the superstructure of brick and steel, with floors of slow-burning mill construction. The pattern shop occupies 160 feet of the north end and is two stories high. The floor of the second story is suspended from the roof trusses to free the first story from columns, thus providing ample space for handling large patterns which will be made there. Adequate facilities have been supplied for the kiln-drying and storing of wood, and for the handling of the latter and the manipulation of patterns. The building is equipped with hydraulic elevators of ample size.

The shop is supplied with a most complete equipment of tools and appliances for wood-working. The windows and skylights have been made large to admit plenty of light. Artificial illumination of the most approved character has been supplied, whereby the general lighting of the building is accomplished by arc lamps and the direct illumination of the tools and work is effected by means of Nernst lamps. In winter a mean temperature of between fifty and sixty degrees Fahrenheit is preserved by means of a hot air system of heating, the air being forced by rotary fans through coils heated by either exhaust or live steam furnished from the power-house. Ample lavatories and toilet

General View of Foundry Showing 100-Ton Sellers Crane.

conveniences are supplied on each floor, and in every way the comfort of the employés has been studied.

The remaining portion of this building, which is devoted to the storage of patterns, has three floors, the two upper ones being divided by interior firewalls into three separate compartments. The floors themselves are of three-inch yellow pine covered by one thickness of maple flooring. The roof purlins are steel I-beams spaced eight feet *c* to *c* and covered with three-inch roof sheeting and slate.



Showing Rack for Pattern Storage—Third Floor of Pattern Storage Building.

Automatic sprinklers are installed throughout this building, and the system of hot air heating previously referred to keeps a mean temperature about thirty-five degrees Fahrenheit in zero weather, to prevent freezing of the water in the pipes. Risers for hose connection are supplied for additional fire protection.

Ample elevator facilities have been provided for handling patterns and a system of racks, each containing several tiers of shelving subdivided into sections, has been installed on each floor for the storage of those of the smaller sizes. A system of marking and recording the patterns by the number of rack, tier and section to which they have been assigned, secures their permanent location.

THE FOUNDRY BUILDING.

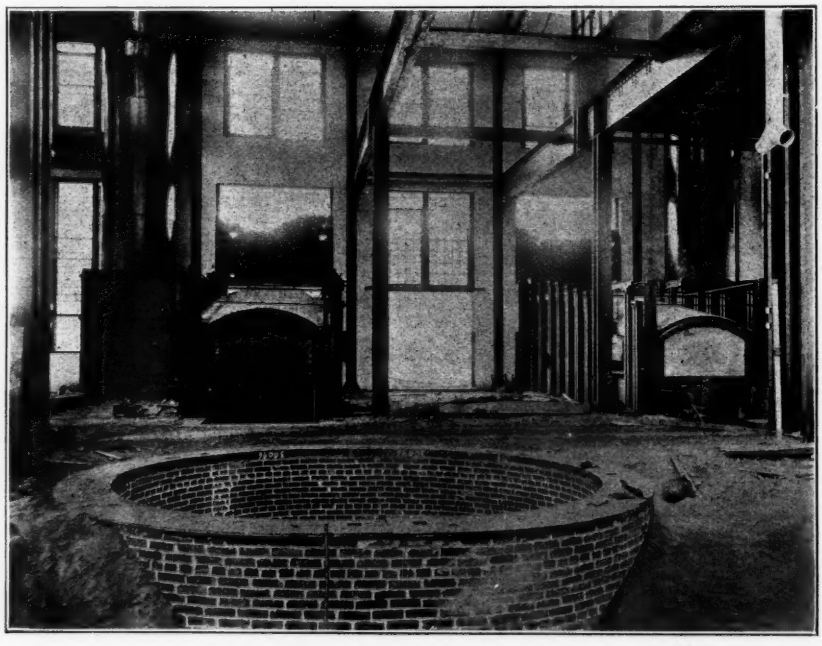
The first building for foundry purposes, which is now erected and in operation, adjoins the pattern shop, with a space of 100 feet between them. It is of brick and steel construction on concrete foundations, and is 612 feet long by 184 feet wide. The walls are thirty-six feet high at eaves and eighty feet at peak. It is divided transversely into three bays, the centre bay being eighty feet wide and those on either side fifty feet six inches wide. These bays are traversed by traveling cranes, the centre having one of 100 tons and two of sixty tons capacity, all of the Sellers two-trolley type, and each of the side bays has three of the Morgan type of twenty tons capacity each.

The centre bay has in addition on either side special runways underneath those for the cranes just mentioned, and these accommodate four traveling jib cranes, two on each runway. These cranes reach out into the centre bay about thirty-five feet, and as the largest moulds will be arranged close to the side posts they are thus intended to handle all the work of setting and drawing patterns, setting cores, and, in fact, are capable of doing all the work of the foundry except that of the very heaviest nature. A track from the main railroad system runs through each end of the building to cooperate with the larger cranes in the transportation of material to and from the foundry, and the narrow-gauge railroad traverses the side bays from end to end and works conjointly with the smaller cranes previously mentioned.

At the side of the building is a space 100 feet wide which serves as a storage yard for flasks and heavy apparatus connected with the foundry operations. In the centre of this yard also is stored the fuel and raw material for charging the melting furnaces. To serve the yard, runways are provided and equipped with a Sellers double trolley traveling crane of fifty tons capacity.

THE MELTING DEPARTMENT.

At the middle of the north bay is located an elevated charging platform to which the raw material is raised on lifts operated by hydraulic power supplied from the power plant. The melting equipment consists of three cupola furnaces of eighteen tons capacity per hour each, located on this platform, and two air furnaces each of thirty tons capacity placed close by on the ground. As it is not uncommon practice in foundry work to hold molten metal for three hours or more, it would easily be possible here to pour a casting of 200 tons in weight, should such a requirement ever be made.



Showing Two 30-Ton Air Furnaces and Ladle Pit.

By the use of the air furnace method of melting iron, metal fifty per cent stronger than that obtained from the cupola may be obtained, so that all large and important castings are usually made of the former metal. Across the building and opposite the melting plant are the core ovens. These are arranged to be heated either by coke or natural gas, as may be deemed expedient.

THE HEATING SYSTEM.

Rotary blowers are placed on platforms under the roof and operated by two-speed motors. These blowers force air through coils heated by either live or exhaust steam from the power plant, and, by means of ducts, properly distribute heat throughout the building at a minimum temperature in zero weather of fifty degrees Fahrenheit.

The automatic sprinkler system is installed and adjusted to operate at varying temperatures according to the nature of the work in different localities.

THE OFFICE, BRASS FOUNDRY BUILDING.

Close to the viaduct and adjacent to the main approach to the foundry buildings is located a brick building of two stories in height in front, which part is occupied on the first floor by the business office of the Westinghouse Machine Company's foundry department, and the superintendent and his staff. The second floor is used as a drafting room. The rear of this building, from which the floor of the second story has been omitted, serves as the brass foundry. This room is forty feet by eighty feet in size and contains six pit furnaces, together with the usual accessories of a modern brass foundry.

The quotum of brass moulders which this building can accommodate is about twenty.

THE SAND HOUSE.

This building is of wooden frame construction, thirty-four feet wide by 128 feet long, located adjacent to the foundry building. It is paralleled by a track of the main railroad system for receiving the sand, and a track of the narrow-gauge railway leads into the building to receive the sand from the mixers for the foundry.

THE LABORATORY AND LAVATORY BUILDING.

In the space between the pattern storage building and foundry is a two-story building thirty-four by sixty feet, of brick and steel construction.

The rear of the upper floor of this building is equipped as a chemical laboratory, and the front part is devoted to offices for the foremen of the foundry.

Intermediate between the front and rear are quarters for the janitor and a room to be devoted to first aid to the injured.

The lower floor is devoted to lavatories. It is equipped with the best modern outfit of wash-basins, shower baths, and closets, and is so arranged that each employé is supplied with his individual locker.

By isolating this building for its specific purposes, the foundry buildings can be kept in the very best sanitary condition, and attendants ensure the safe keeping of the clothing and property of the employés during their hours of service.

The total number of men which this foundry is prepared to employ in normal times, in all the varied occupations incident to its operation, is about 600. In busy times, however, as many as 1,000 men can be readily accommodated through the adjustability of the facilities for expansion that have been provided.

In the preparation of the design, construction and equipment of this foundry, which was carried out under the direction and supervision of the Westinghouse Machine Company, of East Pittsburg, a most complete study of the great foundries of the world was made and the best features of all are here embodied, so that the arrangement, as here shown, represents the most approved characteristics of modern foundry practice.

SIDE BAY OF FOUNDRY, SHOWING TRAVELING CRANE.

Electrical Notes from Europe.

From Our Special Correspondent.

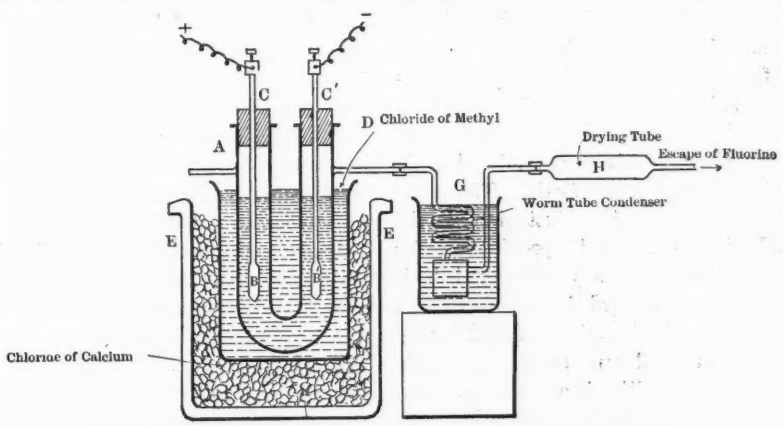
ONE of the large hydraulic plants of Italy is that which has been erected at Bussi for supplying an electrochemical works in the vicinity. The plant has been installed by the Volta Electrochemical Company, of Rome. The electrochemical works, which belong to the same company, produce for the most part caustic soda and chloride of lime. The hydraulic station at Bussi is equipped with seven direct-coupled turbine groups of 450 horse-power each, operating at 450 revolutions per minute. The turbines have been supplied by Piccard and Pictet, of Geneva, one of the largest Swiss firms. They are coupled to direct-current generators of the Oerlikon type, which have been specially designed to give a high current capacity for electrolytic work. The output of these machines is 1,500 amperes at 180 volts. At present there are six machines which supply current, while the seventh is used as a reserve. Each of the generators supplies one of the electrolytic apparatus which are installed in the neighboring factory. The seventh machine is used to supply current for six motors, ranging from 20 to 100 horse-power, which are needed in the different processes. Each of the generators is provided with a small switchboard. Besides the heavy-current groups, the hydraulic plant contains two turbine-driven alternators of 450 horse-power each, working at 450 revolutions per minute. The alternators give three-phase current and work at 6,000 volts and forty-five cycles. These machines are used to supply a high-tension line which runs from Bussi to Piano d'Orta, at nine miles distance. The line uses three wires of seven millimetres diameter. At the last-named point the current is received in a substation containing a switchboard, which distributes it to two different lines. One of these circuits is used to supply two non-synchronous motors which use the high-tension current of 5,000 volts, directly. These motors give 220 horse-power each. The second line feeds three step-down transformers of thirty kilowatts each for the local lighting circuits. The entire plant has been installed by the Oerlikon Company, of Zurich.

A very successful tramway system is that which has been lately installed by the Fives-Lille Company, one of the large Paris electrical firms, in the Alpine region of France. It connects the Moutiers railway station with the town of Brides-les-Bains which is a well-known health resort of the region, and it is proposed to extend the line as far as Villard, when its length will be doubled. The tramway is supplied with current from an hydraulic station which is situated on the Alloues, a mountain torrent which pours into the Doron river at Brides-les-Bains. A head of water of 360 feet is secured at this point. From the dam which is erected across the stream, the water is sent into several settling reservoirs and is then taken to the hydraulic station by a penstock three feet in diameter which descends along the mountain side for 2,500 feet. The station contains three main turbines, each of which is built for 260 horse-power, and works at 370 revolutions per minute. These turbines are provided with an improved form of automatic governor and each is direct-connected by an elastic coupling with a direct-current machine of the Fives-Lille pattern, which is over-compounded and furnishes 160 kilowatts, with a voltage varying from 500 volts no load to 600 full load. From the main switchboard start the circuits which supply the tramway. When completely finished the road will be about eight miles long. The current is taken from a double trolley wire, with rail return. The cars have been equipped by the Fives-Lille Company and are mounted upon a double-axle truck, with a motor on each axle. The gauge of the road is one metre and the cars, which are twenty-six feet long, hold forty to fifty passengers. The motors are built to give twenty-five to forty horse-power each, with a voltage varying from 400 to 600. The controllers of the series-parallel type, which are mounted upon each platform, contain two cylinders which are operated by levers. The larger cylinder serves to give the different connections of the motor circuits which correspond to various speeds, while the second is used to give the forward or reverse movement, with one or both motors in circuit. The controller has a special contact which allows the motor to act as an electric brake. This manoeuvre is carried out by a simple movement of a lever. At present but one of the generators of the hydraulic plant is in use for the tramway lines, but when the road is extended as far as Villard two of the machines will be needed, with the third as a reserve. It is expected that the company will establish a system of freight traffic and use trains made up of a motor car, trailers and freight cars, as the road covers a region which contains a number of large factories. Among the latter may be mentioned the works of the Compagnie Generale d'Electrochimie which uses the current of an hydraulic plant for manufacturing various electrolytic products. The station, which has been erected for the purpose, uses a fall of 800 feet with a penstock 7,500 feet long and three feet diameter. The plant contains six turbine and dynamo sets of 500 kilowatts each. These machines, which have been supplied by the Fives-Lille Company, are of the eight-pole, direct-current type and work at 300 revolutions per minute, furnishing 200 volts. Adjoining the station is the large electrolytic works which is chiefly engaged in the production of carbide of calcium and ferro-silicon.

A Danish scientist, Th. Sundorph, has been making a series of experiments upon the passage of current between two bodies which are but slightly in contact. This question is one of great interest as it relates to the phenomena which take place in coherers. The experimenter examines in the first place the action which occurs at the point of contact of two wires which are laid one across the other at right angles. According to his researches, the resistance of the contact between the two wires depends upon different factors, namely, the pressure existing at the contact, a counter-electromotive force which seems to be set up in such cases, and also upon the resistance of a thin layer of water vapor which is condensed upon the surface of the wires and that of a layer of metallic oxide which may exist between the two bodies. In the case of such contacts he observes that the resistance increases considerably as the current is diminished. With two wires touching each other there is a considerable adhesion between the two, which is kept up even after the current has ceased to pass. This adhesion is probably due to the action of particles of metal which are detached from the wire and form a bridge between them, and this phenomenon occurs under the action of the spark of the extra current each time that the wires are separated from each other. Analogous phenomena are presented in cases where there are several points of contact, for instance, where metal filings are used. The filings

are placed between two brass points. When examined under the microscope the filings are observed to take a back and forward movement which is quite characteristic.

Professor Henri Moissan has lately perfected his electrolytic apparatus for producing pure fluorine, and has been making a number of interesting experiments with it at the laboratory which has been fitted up for him at the Sorbonne. It will be remembered that M. Moissan was the first to produce fluorine in the gaseous state and set it free from its compounds. He afterward examined the properties of the gas and its different compounds. More recently in connection with Professor Dewar, he succeeded in liquefying and even in solidifying fluorine, by using liquid oxygen and finally liquid hydrogen. The gaseous fluorine is produced in an electrolytic apparatus which is shown in section in the diagram.



MOISSAN ELECTROLYTIC APPARATUS FOR PRODUCING FLUORINE.

It consists of a copper U-tube A, about eight inches high and one inch diameter. Each arm of the tube is corked by a stopper of fluorspar CC', through which passes a platinum rod B serving as an electrode. The rod is somewhat enlarged at the base so as to provide for the attack of the liquid. The electrolyte is hydrofluoric acid, which is specially prepared in a pure state. The U-tube has a small tube at each side for the escape of the hydrogen which is given off at one pole and the fluorine gas which comes off at the other. The hydrogen is allowed to escape into the air, while the fluorine is taken off by a small copper tube which is connected to a purifier. The U-tube is placed in a vessel D filled with chloride of methyl which has a temperature of minus twenty-three degrees centigrade, as the apparatus tends to heat up under the action of the current. The whole is surrounded by a larger vessel E filled with fragments of chloride of calcium. The fluorine gas which comes off is freed from impurities by passing it into a small worm condenser G of platinum surrounded by a cooling bath of chloride of methyl, in order to condense the vapors which come over. Beyond the condenser is a drying tube H filled with chloride of calcium. In this way M. Moissan obtains fluorine gas in a practically pure state. The gas can be ignited on coming out of the apparatus and it burns with a blue flame. A current of forty to fifty volts and fifteen amperes is generally employed. The fluorine thus produced is a seemingly colorless gas with a strong odor. When viewed in a tube three feet long the gas is seen to have a slightly yellowish color, but is less so than chlorine. Fluorine is remarkable for its powerful chemical affinity which is greater than for any other element. Different bodies, such as carbon, sulphur and phosphorus, burn in the gas with a brilliant incandescence and form a series of compounds which are of great interest. Fluorine has been liquefied by cooling it to minus 187 in liquid oxygen and gives still more powerful reactions. When a piece of phosphorus is dropped into the liquid, it burns with a bright flame, accompanied by clouds of fumes. Crystallized anthracene causes a violent explosion when placed in the liquid fluorine. The last step has been to solidify fluorine, and this has been accomplished recently by placing liquid fluorine in a narrow tube and cooling it by dipping into liquid hydrogen. The fluorine then solidifies in a yellowish mass. The experiments with liquid fluorine are remarkable as showing that chemical affinity still holds good, and, even in a large degree, at as low a temperature as minus 187 degrees centigrade.

Apropos of Professor Moissan's production of the diamond in the electric furnace it appears that in spite of the conclusive results which he obtained, there are some persons who remain sceptical as to the formation of the diamond by artificial means. It is stated that M. Charles Combes, a prominent engineer of Paris, has recently challenged Professor Moissan to produce the diamond before a committee of specialists to be named by both parties. He offers to lay a wager of $1,000 to this effect. This question has awakened considerable interest, owing to the prominent position of both parties. It is not as yet known whether Professor Moissan will consider it necessary to respond to such a proposition.

The electric lighting of St. Peters at Rome was decided upon over a year ago, and has since been carried out with great success. The new electric lighting has proved much more satisfactory than the former system of gas lighting, as the latter gave a greater fire risk and it was not always possible to hide the unsightly pipes among the interior decorations. The current is taken from the city mains, which furnish alternating current at a tension of 2,000 volts. The high-tension current is taken off by Siemens concentric cables which are brought to the rear of the church and into a small chamber which is situated on the ground floor at the bottom of the winding staircase which leads to the cupola. In this chamber are located two primary switchboards. From this point the wires mount the opening of the staircase and come out at a considerable height, on a level with the main cornice which runs around the dome. At this point is a roomy chamber in which has been installed a set of two transformers of 110 kilowatts capacity each, in order to lower the tension to 110 volts for the lamp circuits. On the outside of the chamber has been placed a marble switchboard which is used to make the connections of the primary and secondary circuits. From the switchboard start the four main 110-volt lighting mains, each of which has a double-pole switch and a fuse block. The main circuits are laid around the dome, where there are different corridors and staircases, so that the lines are easily accessible. From this main circle are four branches which pass to the front and rear and on either side. To light the immense interior of St. Peters requires 628 incandescent lamps, which are generally of twenty-five candle-power each; in some cases ten-candle-power lamps are used. These lamps are usually distributed in large chandeliers which are hung from the ceiling. The total lighting represents 14,000 candle-power. The lighting circuits have been laid out so as to provide for considerable increase and this can be raised as high as 80,000 candle-power. The main circuits have been laid out so as to secure a nearly uniform voltage, they have a total length of nearly two miles. For the lamp circuits the total length of copper wires or cables is fifteen miles.

C. L. DURAND.

Paris, October 3.

ADDRESS TO THE ENGINEERING SECTION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.[1]

BY CHARLES HAWKSLEY, PRESIDENT OF THE SECTION.

TECHNICAL EDUCATION.

The subject of the technical education of engineers was treated very fully in the interesting address delivered by Professor Perry, as president of Section G at the meeting of the British Association in Belfast last year. This question also received thorough consideration at the meeting of the engineering conference held in London in June last, as well as at recent meetings of the Institution of Mechanical Engineers and of the Institute of Naval Architects. The systems in vogue in the United States of America and on the Continent of Europe were on those occasions brought forward in carefully prepared papers and fully discussed. The main points at issue are: (1) whether actual handicraft should be taught in the technological school or college along with the principles underlying the engineers' art; (2) whether the year should be divided into periods in one or more of which the science of engineering should be taught, and in another or others of which craft skill should be acquired at works; (3) whether the principles should be first acquired, during a longer or shorter term, leaving experience in applying those principles to be gained at the termination of the course. As regards the first of these suggestions it appears to be in opposition to the judgment of the most experienced teachers. In respect to the second, the Admiralty has carried it out for the last forty years, and with satisfaction to the service; it is also common in Glasgow, and Mr. Yarrow has included this system in the apprenticeship rules he has recently laid down, while it is to be tried experimentally in the engineering course at King's College, London. At the engineering conference it was determined that the subject was of such importance that its further consideration should be left to a committee, to be subsequently appointed.

Before leaving the subject of technical education, I venture to express the hope that in the training of engineering students increased attention will be paid to the combination of artistic merit with excellence of structural design, so that in respect to artistic treatment our engineering structures may not remain so far behind those of our Continental brethren as is unfortunately now frequently the case.

[1] Paper read before the British Association for the Advancement of Science, Southport, 1903.

ENGINEERING STANDARDS.

A very important work has been going on quietly and unostentatiously in our midst for some time past, the results of which must affect the engineering profession at home and abroad. I refer to the work of the Engineering Standards Committee, which, as many of my hearers know, was appointed in 1901 and is now composed of 178 members, among whom are many government officials. The committee has received not only the moral but the financial support of his Majesty's government, and the results of its labors are being adopted by all the leading government departments.

In addition to the main committee there are no fewer than twenty-five separate committees and subcommittees engaged on work, covering a wide range of operations, many of the members sitting on more than one committee.

After careful deliberation the committee published its first series of British standard sections, covering all rolled steel sections used in constructional work, shipbuilding and so forth. The committee on rails has just issued the standard sections and specification for British girder tramway rails, and it is now actively engaged in drawing up a series of standard sections of bull-headed and flat-bottomed rails for railway work.

Another committee is occupied in drawing up a standard specification and standard tests for cement.

The government of India controls to a very considerable extent the working of railways in India, and has referred to the Standards Committee the important question of drawing up a series of standard types of locomotives for use on the Indian railways. The committee which investigated this difficult subject has just forwarded its report to the Secretary of State for India. Other committees are preparing standard specifications for locomotive copper fire-box plates and steel boiler plates, which it is hoped will be published at an early date.

Other committees are considering screw-threads, standard flanges and standard cast-iron pipes and specifications for material used in shipbuilding. There are about a half dozen committees engaged on various important electrical subjects.

In my presidential address before the Institution of Civil Engineers in 1901, I raised a note of warning in regard to the stereotyping of design and the consequent cramping of originality. The constitution of the Standards Committee and the professional standing of its members afford a guarantee that its work will accord with the best practice of this country, since those engaged in drawing up the standards are not only in the forefront of engineering practice, but are alive to the necessity for extending the number of standards if and when needed to meet the requirements of the engineer.

NATIONAL PHYSICAL LABORATORY.

An outline scheme for a National Physical Laboratory was set forth in 1891, by Sir (then Dr.) Oliver Lodge, F. R. S., in his address at Cardiff to Section A of the British Association. In his presidential address to this association in 1895 at Ipswich, the late Sir Douglas Galton, F. R. S., emphasized the importance of such an institution, a committee of this association reported in favor of it, and later, when after forwarding a petition to the late Lord Salisbury, a treasury committee with Lord Rayleigh, F. R. S., in the chair was formed, Sir Douglas Galton gave evidence to the effect that if Great Britain was to retain its industrial supremacy, we must have accurate standards available to our research students and to our manufacturers.

In 1901, the National Physical Laboratory was inaugurated at Bushy House, near Teddington, and an annual grant of £4,000 toward its support was made by the government. It is divided into three departments, of which the one dealing with all branches of civil, mechanical and electrical engineering is chiefly interesting to us in Section G. In this department tests are now undertaken of the strength of materials of construction, of pressure and vaccum gauges, of indicators and indicator springs, and of length gauges and screw gauges, and photomicroscopic investigation is made of metals and alloys, and especially of steel rails.

But besides the ordinary work of testing, various investigations are in progress, such as measurement of wind pressure, elastic fatigue in nickel steel and other materials used by engineers, and the magnetic and mechanical properties of aluminum-iron and other alloys. For the British Association a set of platinum thermometers has been constructed and subjected to stringent tests, and an investigation has been undertaken for the Engineering Standards Committee into the changes in insulating strength of various dielectrics used in motors, transformers, etc., due to continued heating. In the language of Dr. Glazebrook, F. R. S.,

the director, who it may be mentioned was previously principal of University College, Liverpool, science is not yet regarded as a commercial factor in this country, but it is one of the aims of the National Physical Laboratory to bring about the alliance of science with commerce and industry. The expenditure of the National Physical Laboratory is met by an annual Treasury grant of £4,000; £500 a year from an endowment; fees for tests, now amounting to about £3,500 annually; and from donations and subscriptions.

The director is anxious that the revenue derived from fees for testing should be largely augmented, and I would urge on engineers, contractors and manufacturers, as well as on private individuals, that they should avail themselves of the opportunity to have tests and experiments of interest to them, and which will be generally accepted as unimpeachable, conducted at this laboratory. I may add that an appeal has been made for further donations and annual contributions, as the funds now at the disposal of the board of management are insufficient to carry on the work of the laboratory on a sound financial basis, and I venture to hope that many of those who are interested in the practical applications of science will assist in supporting the work of this national institution.

INTERCOMMUNICATION—GENERAL PROGRESS.

At the commencement of the nineteenth century the population of the United Kingdom was nearly fifteen and three-quarter millions, at the beginning of the twentieth nearly forty-one and one-half millions. Then there was not a mile of railway in the United Kingdom: now there are about 22,000 miles. Here, too, is evidence not only of the prosperity which has prevailed throughout Great Britain during the century that has passed, but also of the enormously increased demands which have arisen during the same period on the means of locomotion.

In 1803, just one hundred years ago, Telford reported to the government on the state of the roads, and as a result the great road to Liverpool from the metropolis and the other great highways were constructed. It was enlightened wisdom that eighty years ago placed intercommunication in the forefront of the definition of engineering; it still maintains that position, and I purpose to say a few words on the present aspect of the question.

ROAD TRAFFIC—MOTORS.

Speed in locomotion appears to be now the first consideration, whether as regards mails, passengers or goods. I would refer in the first instance to locomotion on our main roads. Here three or four classes of machines appear to be ambitious to drive pedestrians, horsemen and horse-drawn vehicles off the road.

The first practical steam carriage was used by Trevithick in the year 1802; and now a hundred years later, it is found that for the traction of heavy loads on the main roads steam is still most suitable. The points of importance in connection with traction engines and their trailers are their speed, weight and width; of course, there is no question that, as regards facilitating traffic, the large heavy wagon replacing many smaller horse-drawn ones will be found a boon, but it must be remembered that the momentum of heavily laden wagons drawn by a powerful traction engine at the maximum speed of five miles an hour, is very great and causes uncomfortable vibration in the houses along the main thoroughfares of our towns; on the other hand, light traction engines are now being successfully used, drawing from four to five tons of market produce through the streets of London without causing undue vibration, and at a cost, I am informed, of about one-half that of horse traction.

But a far more burning question is that of the speed of motor cars along our public throughfares. Between racing speed and ordinary traveling speed there is necessarily a great difference, and our twenty miles maximum on country roads is in excess of that allowed in France, where it is now fixed, though I believe not enforced in the open country, at eighteen and one-half miles, and at twelve and one-half miles where there is much traffic. The two classes of motors used for higher speeds are the petrol and the electric. The former are mainly internal-combustion engines; having to be light, they run at the comparatively high speed of 800 revolutions per minute. They are generally used in connection with bicycles, tricycles or light carriages. They have also been used for light vans and coaches, and successful trials have been made with self-propelled lorries for military purposes, and by local authorities for watering and dust collecting. Their application to omnibuses has not proved economical, owing to the difficulty of providing pneumatic tires for such heavy vehicles.

The electric motor depends on storage batteries; those in general use are of Planté's lead-couple type. Like the petrol motor, the electric motor is rather a luxury; most of the automobile carriages used in London are of this class; there is liability of injury to the batteries by over-discharging them. Colonel Crompton, in a paper recently read at the engineering conference suggested the use of "standardized accumulators," to be supplied to the owners of electrical vehicles at depots on production of the subscription ticket, and the Engineering Standards Committee has appointed a sub-committee to consider the question. Motor cars are now used by some of the railway companies as feeders to their lines, and also in competition with tramway lines.

The increasing use of motor cars renders more than ever necessary the regulation of traffic in crowded thoroughfares, a subject which will doubtless be dealt with in the paper on "The Problem of Modern Street Traffic," which Colonel Crompton is about to read before this section of the British Association.

The use of motor-driven vehicles for road traffic is so intimately associated with improvements in prime movers that it will interest the members of this section to be reminded of the opinion expressed more than twenty years ago by Sir Frederick Bramwell, who presided over the meeting of the British Association at Bath in 1888. In a paper read before this section at the jubilee meeting of our association at York in 1881, Sir Frederick Bramwell said: "However much the mechanical section of the British Association may to-day contemplate with regret even the mere distant prospect of the steam engine becoming a thing of the past, I very much doubt whether those who meet here fifty years hence will then speak of that motor except in the character of a curiosity to be found in a museum." In a letter addressed to the president of this association on July 2 last, Sir Frederick Bramwell drew attention to the largely increasing development of internal combustion engines, and expressed a feeling of assurance that although steam engines might be at work in 1931, the output in that year would be small of steam as compared with internal combustion engines.

To keep alive the interest of the association in this subject, Sir Frederick Bramwell has kindly offered, and the council has accepted, the sum of £50 for investment in two and one-half per cent self-accumulative consols, the resulting sum to be paid as an honorarium to a gentleman to be selected by the council to prepare a paper having Sir Frederick's utterances in 1881 as a sort of text, and dealing with the whole question of the prime movers

of 1931, and especially with the then relation between steam engines and internal combustion engines. That paper will doubtless prove to be a very valuable contribution to the proceedings of this association, and one can only regret that many of those assembled here to-day can not hope to be present when it is read, and to listen to an account of the nearest approach which has then been made toward the production of a perfect prime mover.

ELECTRIC TRAMWAYS AND LIGHT RAILWAYS.

I now pass to the application of electricity to tramways, and in so doing may quote from the careful expression of opinion given in this town from this chair twenty years ago by the late Sir (then Mr.) James Brunlees, president of the Institution of Civil Engineers: "The working of railways by electricity has not advanced further than to justify merely a brief reference to it in this paper as among the possibilities, perhaps the probabilities, of the not distant future."

It was stated in a paper read by Mr. P. Dawson in April last before the Tramways and Light Railways Association, that the total route-length of electric tramways and light railways in the United Kingdom, either completed, under construction or authorized, amounted at the end of last year to 3,000 miles, the length of single track being 5,000 miles, on which some 6,000 cars were running.

It can not, in my opinion, be regarded as being fair to the railway companies—which have to pay large sums of money for the land on which their lines have been constructed—to have to compete with tramways which are laid along the public roads without any payment being made for their use. The roads are disfigured by aerial conductors and the supporting posts by which the electric current is conveyed to the cars, except in those comparatively rare instances in which the conduit system is used; nor can it be denied that tramways greatly interfere with the use of the roads for ordinary traffic. The effect of electrolytic action on iron pipes laid beneath the roads is still undergoing investigation.

RAILWAYS.

Railway companies are turning their attention to the introduction of electric traction wherever it can be beneficially used, as for instance on the Mersey Railway, the North-Eastern Railway between Newcastle-upon-Tyne and Tynemouth, and the Lancashire & Yorkshire Railway between Liverpool and Southport. With the object of facilitating the introduction and use of electrical power on railways, Parliament has passed an act entitled the "Railways (Electrical Power) Act, 1903," which will come into operation on January 1 next.

The electrical service on the Mersey Railway has now been in regular and uninterrupted operation since the beginning of May in the present year. Trains are run at three-minute intervals, there being 750 trains in all between 5 A. M. and 12 midnight; and as it is the first example of a British steam railway converted to the use of electric traction, a short description if it can not fail to be of interest.

Of tube railways with electric traction there are three now working in London, two between the city and the south side of the river Thames, using the ordinary two-wire 500 volts continuous-current system, and another (the Central London) extending from the city to Shepherd's Bush, using the composite system. This railway conveyed during the year 1902 no fewer than forty-five million passengers. There are eight other tube railways now in course of construction in London. The recent terrible catastrophe in Paris must serve as a warning in the future equipment of such lines where currents at high tension are employed, and where short-circuiting may bring about disastrous results.

WIRELESS TELEGRAPHY.

In addressing this section I feel that I ought to say a few words on the subject of "wireless telegraphy." With regard to signaling Signor Marconi certainly seems to have made progress. In January, 1901, signals were conveyed from Poldhu in Cornwall to the Isle of Wight, a distance of 200 miles, and in December of the same year, between Cornwall and St. John's, Newfoundland, a distance of 2,000 miles. In the year 1902 signals were transmitted from England to the Baltic and the Mediterranean, which had thus passed over both sea and land. It seems to be not improbable that signals can be sent any distance, so long as the sending station can develop sufficient energy. The question of "syntonism," by which it is proposed to assure the secrecy of messages, appears to be still *sub judice*, but is undergoing further investigation.

There appears to be a practical field for the development of "wireless telegraphy," more especially where ordinary telegraphy can not be applied, as, for instance, between shore and ships at sea or between one ship and another.

The Marconi Wireless Telegraph Company has obligingly furnished me with a list of eighteen land stations fitted on the Marconi system for commercial ship signaling, together with a list of forty-three passenger steamers already furnished with the Marconi apparatus, thus affording evidence of its application to practical purposes.

The system of "wireless telegraphy" by Sir Oliver Lodge and Dr. Muirhead has, I understand, been fitted to cable steamers of the Eastern Extension Telegraph Company, to enable communication to be made with its cable stations.

The remainder of the address was given to the discussion of sewage disposal, irrigation and water supply.

Surface-Contact System Accepted.

After a long period of waiting, the council of the city of Wolverhampton, England, has decided to accept the surface-contact system built for it by the Lorain Steel Company, Lorain, Ohio. The Lorain Steel Company built the line, and installed it free of cost, the city agreeing to purchase it if at the end of a stated period it should be found that the system was practical. The system is the invention of Mr. W. Milt Brown, of the electrical department of the Lorain company.

Electric Car on the Marienfelde-Zossen Line Breaks all Speed Records.

On October 6, an electric car on the Marienfelde-Zossen experimental line reached a speed, it is reported, of 125.45 miles per hour, or a kilometre more than the highest previous record. The machinery and roadbed were unimpaired. The engineers are determined to try for still higher speeds and venture the opinion that they will be able to attain the rate of 140 miles per hour.

The current was between 13,000 and 14,000 volts, capable of driving the car at the rate of over 200 miles. This power is reduced by transformers to about 450 volts. The car used in this test had four motors, having together about 1,100 horse-power. It was the car used in the previous tests this year, and is constructed on the Siemens-Halske system. Another car of somewhat different equipment as to motors and transformers has been built for additional high-speed tests.

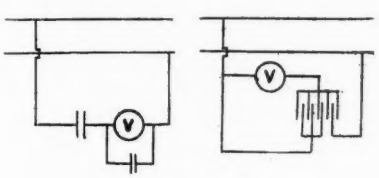
There were twelve to fourteen persons on board the car, all technical men. They affirm that the motion of the car was no greater than that of an ordinary express train. A curious phenomenon accompanying the car is the continuous sparkling of electricity from the six trolley arms.

While the engineers do not believe a speed of 125 miles is practicable at present on the state railroads, they are prepared to recommend a speed of ninety-three miles an hour between Berlin and Hamburg.

ON THE USE OF CAPACITIES AS MULTIPLIERS IN CONNECTION WITH ELECTROSTATIC VOLTMETERS ON ALTERNATING-CURRENT CIRCUITS.[1]

BY E. W. MARCHANT AND G. W. WORRALL.

The measurement of high-potential differences necessitates the use of voltmeters more or less cumbrous and expensive, since in all electrostatic instruments there is a liability to sparking between the plates. High-potential differences may, however, be measured by lower-reading voltmeters in several ways. The only methods hitherto adopted have been by the use of non-inductive resistances connected in series with the voltmeter, either shunted or unshunted, and by the use of transformers. The first method becomes quite impracticable with high pressures on account of the large waste of power involved, while the latter method becomes equally cumbrous on account of the difficulties of insulation and the length of wire required in winding the apparatus. The experiments described below have been directed to the construction of a simple and easily



FIGS. 1 AND 2.

made apparatus by which low-reading electrostatic voltmeters may be employed on circuits of much higher tension. The voltmeters used were of the Kelvin multicellular and Ayrton and Mather electrostatic types. The method of combining the voltmeter with the capacities is to connect a capacity in series with the voltmeter across the mains and shunt another capacity across the terminals of the voltmeter, the latter capacity being large compared with the capacity of the voltmeter. Fig. 1 is a diagram of the connections.

Consider two capacities connected in series across the mains.

Let C_1 and C_2 be the values of the capacities in farads;

R_1 and R_2 be their respective insulation resistances;

V_1 and V_2 be the respective potential differences between the terminals of the capacities;

E be the total potential difference between the mains;

I_r be the resistance current between the mains;

I_c be the capacity current between the mains;

I be the total current between the mains;

p be 2π (frequency per second).

Total current in capacity 1 =

$$V_1\sqrt{\left(\frac{1}{R_1}\right)^2+(C_1p)^2}$$

Total current capacity in 2 =

$$V_2\sqrt{\left(\frac{1}{R_2}\right)^2+(C_2p)^2}$$

These two currents being one and the same,

$$V_1\sqrt{\left(\frac{1}{R_1}\right)^2+(C_1p)^2}=$$

$$V_2\sqrt{\left(\frac{1}{R_2}\right)^2+(C_2p)^2}=I.$$

Now,

$$E=\frac{I_c}{\frac{C_1C_2}{C_1+C_2}p}=I_r(R_1+R_2).$$

Hence,

$$I_c=E\frac{C_1C_2}{C_1+C_2}p, \text{ and } I_r=\frac{E}{R_1+R_2}.$$

Now,

$$I=\sqrt{I_c^2+I_r^2}=$$

$$E\sqrt{\left(\frac{C_1C_2p}{C_1+C_2}\right)^2+\left(\frac{1}{R_1+R_2}\right)^2}=$$

$$V_2\sqrt{\left(\frac{1}{R_2}\right)^2+(C_2p)^2}.$$

Hence, $\frac{V_2}{E}=$

$$\frac{\sqrt{\left(\frac{C_1C_2p}{C_1+C_2}\right)^2+\left(\frac{1}{R_1+R_2}\right)^2}}{\sqrt{(C_2p)^2+\left(\frac{1}{R_2}\right)^2}}.$$

Let $R_1=\frac{x_1}{C_1p}$, and $R_2=\frac{x_2}{C_2p}$. Then

$$\frac{V_2}{E}=\frac{\sqrt{\left(\frac{C_1C_2p}{C_1+C_2}\right)^2+\left(\frac{1}{\frac{x_1}{C_1p}+\frac{x_2}{C_2p}}\right)^2}}{\sqrt{(C_2p)^2+\left(\frac{C_2p}{x_2}\right)^2}}=$$

$$\frac{\sqrt{\left(\frac{C_1C_2p}{C_1+C_2}\right)^2+\left(\frac{C_1C_2p}{x_1C_2+x_2C_1}\right)^2}}{\sqrt{(C_2p)^2+\left(\frac{C_2p}{x_2}\right)^2}}=$$

$$\frac{C_1}{C_1+C_2}\frac{\sqrt{1+\left(\frac{C_1+C_2}{x_1C_2+x_2C_1}\right)^2}}{\sqrt{1+\left(\frac{1}{x_2}\right)^2}}$$

Expanding and neglecting higher terms—

$$\frac{V_2}{E}=\frac{C_1}{C_1+C_2}\left\{1+\tfrac{1}{2}\left(\frac{C_1+C_2}{x_1C_2+x_2C_1}\right)^2-\tfrac{1}{2}\left(\frac{1}{x_2}\right)^2+\ldots\right\} \quad (1)$$

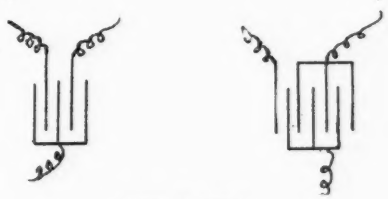
If x_1 and x_2 are very large—that is, if the insulation resistances of the condensers are high—then

$$\frac{V_2}{E}=\frac{C_1}{C_1+C}.$$

From equation (1) it will be seen that if $x_1=x_2$, that is if

$$\frac{R_1}{R_2}=\frac{C_2}{C_1}; \text{ then } \frac{V_2}{E}=\frac{C_1}{C_1+C_2}.$$

This will most probably be the case if the plates of both capacities are of the same size and the sheets of dielectric of the same material, size and thickness, the difference in the values of the capacities being produced by using different numbers of sheets, since, then, both leakage currents through the material and those over the surface of the dielectric will be proportional to the number of plates forming the condensers. If an electrostatic voltmeter, therefore, be connected across the capacity 2, its reading bears a constant ratio to the potential difference between the mains, and by varying C_1 and C_2 any desired ratio may be obtained. Several advantages, such as compactness and saving of material, are gained by forming the two capacities into



FIGS. 3 AND 4.

a condenser, in which one of the two sets of plates is itself divided into two groups, each group connected to its own related main, one group to the voltmeter, and the voltmeter again to the undivided set, as in Fig. 2.

Two instruments have been constructed up to the present on the principles described. One suitable for measuring potential differences up to 300 volts on a 150-volt instrument and having a ratio of $\frac{1}{2}$, and the other suitable for potential differences up to 10,000 volts having a ratio of $\frac{1}{40}$. Fig. 3 is a diagram showing the arrangement of the low-tension instrument. This is formed of alternate sheets of mica and tin-foil of equal dimensions respectively, held together between strong plates of ebonite. Fig. 4 is a diagram showing the arrangement of the high-tension instrument. This is similarly formed, except that copper-foil is substituted for tin-foil, the dielectric varies in thickness directly with the tension, and the whole is clamped between brass plates. The dielectric plates in the

[1] Paper read before the British Association, Southport meeting, September 9 to 15.

higher-tension portion are made larger than those in the lower-tension portion to avoid sparking over the surface, and the entire instrument is suspended in oil for the same reason. The accuracy of the apparatus made has been tested by careful experiments. The measuring instruments used were calibrated at the time of the experiments by comparison with a Kelvin standard balance, and the potential differences for the high-tension instrument were obtained by means of a transformer of known ratio. This ratio was determined at a low-potential difference, and found to be 55.42 and assumed constant; thus the actual voltage in all cases given below is that measured on the primary multiplied by 55.42.

RESULTS OF EXPERIMENTS.

LOW-TENSION INSTRUMENT.

Total Potential Difference Between Mains. E	Reading of Voltmeter. V_2	Ratio. $\frac{E}{V_2}$
139.9	73.4	1.906
149.3	77.7	1.921
162.4	85.1	1.908
174.7	91.0	1.920
185.9	97.2	1 912
196.0	102.5	1.913
204.1	107.8	1.893

HIGH-TENSION INSTRUMENT.

Total Potential Difference Between Mains. E	Reading of Voltmeter. V_2	Ratio. $\frac{E}{V_2}$
6,761	174	39.48
7,426	186	39.92
7,980	204	39.12
8,534	213	40.09
9,089	231	39.34
9,643	243	39.68
10,197	259	39.75
10,751	268	40.11
11,305	283	39.94

The ratios given above in all cases differ by less than one per cent from their mean value, and in most cases agree much more closely. Any variations that exist are well within the limits of experimental error. It is hoped that this device may be of considerable practical utility, not only in simplifying the construction of high-tension voltmeters, but in laboratory and experimental work, where it frequently happens that measurements of potential have to be made with voltmeters, the best parts of whose scales are too low. The invention has been provisionally protected.

Injuries to Shade Trees from Electricity.

Bulletin No. 91 of the Massachusetts Agricultural College contains a report by Dr. George E. Stone, state botanist, upon the effects of electricity and electrical conductors on shade trees. Injuries may be caused by interference with the tree growth by a mass of wires overhead or by contact with wires carrying currents or by lightning. Of the two systems of electrical supply, alternating and direct current, the former is less disastrous to plant life than the latter. When a certain current strength of either kind flows through a tree it accelerates growth and development. There is a minimum strength of current which just perceptibly acts as a stimulus; an optimum, that producing the greatest stimulus, and a maximum, that causing death. Between the optimum and the maximum there is a strength of current that causes retardation. Direct current stimulates less than alternating, and on account of its polarizing effect appears to cause more injury to vegetable life than the same strength of alternating current. Most of the injurious electrical effects to trees arising from trolley or electric light wires are, as a rule, local—that is, the wire causes an injury at or near the point of contact of the wire to the tree. This injury is produced in moist or wet weather, when the tree is covered with a film of water, the result being a burning of the limb. The vital layer of the limb may become partially or entirely killed at the point of contact, and this gives rise to an ugly scar. In a large number of tests made by the aid of sensitive instruments, the author has not in any case found any leakage during fair weather. Results are given of tests made to determine the electrical resistance, but as the measurements were made by means of two nails driven into the wood, much dependence can not be placed upon the relative values for the outer bark, inner bark, the cambium or vital layer, and the wood. However, the minimum value found was about 11,000 ohms for ten feet of the trunk of an elm tree eighteen inches in diameter.

According to observations of the author, the effect of alternating currents on trees is local, injury being produced only near the point of contact. This may result in the death of that portion of the tree; but if it is a leader or a large limb, it frequently has to be sacrificed. He knows of no instance in which alternating current caused the complete death of the tree, though that it is capable of killing small plants has been shown by laboratory experiments. In these experiments the current necessary to kill the plant generated a considerable heat, and this probably caused the death.

The direct currents most usually contended with are those carried by railway feeders. The great majority of burns resulting from the direct current are similar to those produced by alternating currents. They are largely local. These burns are not caused except when the trees are moist, as the high resistance of the wood furnishes a means of protection against death from contact with ordinary currents. The burning in all cases is caused by arcing. Tests were made to determine the amount of current which could be carried by a tree, the current being led in by means of nails driven in the wood. The values found were only a few hundredths of an ohm, and no heating was caused. During wet weather, however, there was always a considerable amount of heat developed while the positive wire was connected to the tree. An examination of this tree ten months later—the connections having been left for several months—showed that the portions of the tissues near the electrodes had been killed.

There are certain cases where large trees have been killed by direct currents from railway circuits. In some of the cases which have come under the author's observation, escaping current has girdled the tree at a distance of five to ten feet, whereas the point of contact of the feed wire with the limb is sixteen or eighteen feet above the ground, and showed none of the characteristic burning effects. An investigation of these unusual results showed that in these cases the positive bus-bar of the system was connected to the rails, and the negative to the overhead conductors; and in all instances where trees were killed by electricity, this was found to be the case.

Lightning, in striking a tree, does not always produce the same results. Trees may be killed outright without exhibiting the common effects of shattering. Quite frequently the tree is girdled by the discharge taking a spiral course to the ground. In a large number of instances lightning strokes cause neither death nor mechanical injury of importance. Hundreds of trees are annually struck by lightning, but this is not recognized except by those who are familiar with the scars which subsequently make their appearance on the trunk.

Brooklyn Rapid Transit Men to Receive Instruction in Electrical Engineering.

At the Railroad Men's Building, Jamaica avenue, Brooklyn, N. Y., on Monday evening, October 5, Mr. Sidney W. Asche, of the Brooklyn Polytechnic Institute, delivered his first lecture to an audience of one hundred and eighty-five men. Thirty-five men enrolled for the course of forty-eight lessons. A complete laboratory is being fitted up by the Brooklyn Rapid Transit Company, which will enable Mr. Asche to give practical as well as theoretical instruction. It is expected that the enrollment will soon reach fifty. On Wednesday classes were organized in arithmetic, penmanship and English.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXX—ON PREVENTING WATER VAPOR FROM ENTERING THE MERCURY PUMP USED IN EXHAUSTING X-LIGHT TUBES.

In exhausting X-light tubes the presence of water vapor in the pump delays the production of a vacuum. Keeping the pump hot was recommended in earlier notes. In the present note apparatus will be described for keeping water vapor out of the pump. Considering how many able men have worked with mercury pumps it is a little strange that water vapor has been allowed to enter the mercury reservoir at every stroke of the pump and to pass up between the mercury and the inner wall of the fall tube into the pump chamber where it has delayed the production of a vacuum in any apparatus attached to the

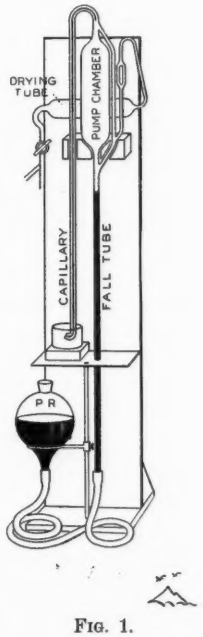


FIG. 1.

pump. Fig. 1 is an illustration of a mercury pump copied from the latest work on gases—"The Study of Gases," by Travers. The pump reservoir PR, containing mercury, is in free contact with the air. The results mention follow, particularly in the morning when the temperature of the pump room is made higher than at night. Under these circumstances when the pump is operated water may be seen in minute drops to collect between the mercury and the inner surface of the fall tube. If an X-light vacuum was left in the pump it may have deteriorated, and bringing it back to the degree it was left may take some time as the water continues to enter the pump chamber with the rise and fall of the mercury. This increase in pressure has been attributed to leaks in the pump and to fine defects in the seals of the X-light tube.

The difficulty can be made less by placing a drying arrangement in the

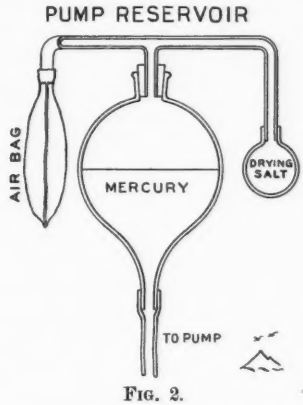


FIG. 2.

path of the air entering the mercury reservoir. To avoid rapid deterioration of the drying chemical it is desirable to close the air inlet with a flexible diaphragm which can expand and contract as the mercury flows into or out of the reservoir. A simple method of applying the principle to the mercury reservoir of the pump shown in Fig. 1 is illustrated in Fig. 2. The mouth of the reservoir is closed by a rubber stopper through which passes a T-shaped tube, on one end of which is a drying bulb, on the other, a tight rubber bag. As no

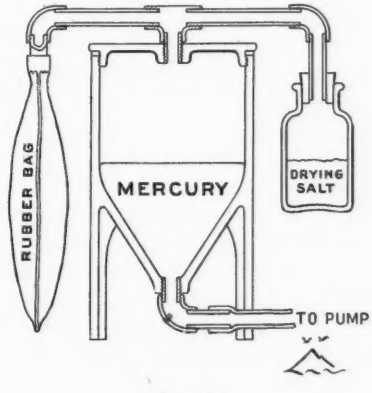


FIG. 3.

external air enters the pump through the mercury reservoir the contained air is kept dry by the drying chemical. To ensure rapid work a mercury pump for exhausting X-light tubes should have a large pump head. Forty kilogrammes of mercury is a considerable mass to have in a glass reservoir, therefore pump reservoirs should be made of iron. One of this kind is shown in Fig. 3. Drying tubes should be also placed at the outlet of the pump. Where the pump is operated by a mechanical air pump which exhausts the air from the pump reservoir, air being admitted by a valve to cause the mercury to rise at each stroke in to the pump chamber, the same precautions against external air should be used.

The Reception Committee of the American Institute of Electrical Engineers.

President Bion J. Arnold has appointed the following gentlemen as members of the local reception committee of the American Institute of Electrical Engineers: Mr. Calvin W. Rice, chairman, Mr. F. C. Bates, Mr. B. Gherardi, Jr., Mr. William J. Hammer, Mr. T. C. Martin, Mr. E. H. Mullin, Mr. Charles W. Price, Mr. Calvert Townley and Mr. Arthur Williams.

A Single-Phase Traction Motor.

A consular report from Berlin gives a brief account of tests made recently in that city with a railway car which is equipped with a single-phase alternating-current motor. The motor was built by the Union Electric Company according to the designs of an Austrian engineer. Power is supplied to the trolley at 6,000 volts and the regulating devices are said to be quite simple. The full voltage is applied to the motor; the frequency is not mentioned. The experimental line is about four miles in length, and the motor is said to have run sparklessly without trouble.

Gutta-Percha from New Guinea.

The Colonial Economic Committee of Berlin announces that the utility of the gutta-percha discovered by the expedition which was undertaken to New Guinea, under the leadership of Herr Schlechter, has been so far established that the gutta-percha from the low-lying country may be regarded as suitable for cable purposes as an admixture, and if carefully obtained, be fit for cables in a pure condition. Large quantities of gutta-percha have been obtained from New Guinea and are at present being tested. It is proposed by the Colonial Economic Committee to establish a gutta-percha enterprise for the education of the native population of New Guinea, in the cultivation of the plant and the harvesting of the gum. For this purpose a fresh expedition will be sent out for a period of three years, and assistance will be given by natives of Borneo and others familiar with the question of rubber production.

The Old Time Telegraphers and United States Military Telegraph Corps.

The twenty-third annual meeting of the Old Time Telegraphers' and Historical Association, together with that of the United States Military Telegraph Corps, was opened on Wednesday morning, September 23, at 11 o'clock, in the rooms of the Merchants and Manufacturers' Association, of Milwaukee, Wis. The opening session was called to order by Mr. John Brant, secretary-treasurer of the association. He requested Mr. S. A. Duncan, of Atlanta, Ga., to present the badge of the presidential office to President U. J. Fry. This badge consists of a miniature portrait of Professor Morse, and it is always worn by the president of the association on the lapel of his coat during the term of each annual meeting.

The Hon. Carl Runge, city attorney of Milwaukee, greeted the 400 attendants who had responded to the invitation of Milwaukee to the Old Timers. President Fry delivered his annual address, and Colonel William B. Wilson, of Philadelphia, thanked the representative of the city of Milwaukee for his warm welcome. On behalf of the Old Timers and Military Telegraphers, Colonel Wilson gave a brief history of the telegraph and the part it plays in the management of the railroads and the transaction of the commerce of the world.

The secretary's report showed that the affairs of the association were in a satisfactory condition.

Mr. C. A. Stimson, of Philadelphia, invited the Old Timers and Military Telegraphers to visit that city on October 30 and 31, to take part in the telegraph tournament. A resolution endorsing and encouraging the tournament was passed.

Atlanta, Ga., was selected as the next place of meeting in 1904, the date of which is to be determined by the executive committee.

The committee on nomination, time and place, consisting of D. C. Sims, W. G. Moffet, John Winthrop, George Henderson and S. A. Duncan, reported the following named as officers for the ensuing year: C. C. Adams, general superintendent of the Postal-Telegraph Cable Company, Atlanta, Ga., president; J. M. Stephens, superintendent of the Western Union Telegraph Company, Atlanta, Ga., first vice-president; W. H. Adkins, traffic manager of the Southern Bell Telephone Company, Atlanta, Ga., second vice-president; John Brant, of New York, secretary-treasurer. An executive committee comprising the following was also elected: U. J. Fry, Milwaukee, Wis.; G. H. Corse, of Ogden, Utah; L. B. McFarland, of Montreal, Quebec, and H. C. Hope, of St. Paul, Minn.

Resolutions of thanks were voted to the railroads for their courtesies and to Colonel Robert C. Clowry, president and general manager of the Western Union Telegraph Company, of New York, for many favors extended. Both telegraph companies and the long-distance telephone company were also thanked for courtesies of free service extended to the members. The convention then adjourned.

UNITED STATES MILITARY TELEGRAPH CORPS.

The meeting of the United States Military Telegraph Corps was called to order at 12.30 o'clock on Wednesday, September 23, by Colonel W. B. Wilson, of Philadelphia, president of the society. There were twenty-five telegraph veterans of the Civil War and four ex-Confederate operators present, in addition to a large number of the members of the Old Time Telegraphers' and Historical Association.

Following President Wilson's report, Mr. J. E. Pettit, of Chicago, secretary-treasurer of the society, read the report, which showed a balance of considerable money on hand.

A vote of thanks was given to Governor Pennypacker, of Pennsylvania, in connection with the presentation of a gold medal by the state of Pennsylvania to Colonel W. B. Wilson, the president of the society, in recognition of faithful services performed during the war.

The old offices were reelected as follows: Colonel W. B. Wilson, of Philadelphia, Pa., president; W. L. Ives, of New York, vice-president, and J. E. Pettit, of Chicago, secretary-treasurer. Executive committee: E. Rosewater, chairman, Omaha, Neb.; A. H. Bliss, W. R. Plum, Chicago, Ill.; Colonel A. B. Chandler and R. B. Hoover, New York; George C. Maynard, Washington, D. C.; D. W. Smith, Breckenridge, Minn.; L. A. Somers, Cleveland, Ohio, and J. D. Cruise, Kansas City, Kan. Atlanta, Ga., was chosen as the next place of meeting, and a vote of thanks recorded for favors extended.

On Wednesday, September 23, the entire party boarded special trolley cars for a trip to the Marconi Wireless Telegraph Company's station on the shore of Lake Michigan, where a demonstration was given and several messages exchanged with Chicago. On the return, a trip was made through the principal streets of the city and suburbs, including a visit to the Soldiers' Home.

The performance of "King Dodo," at Davidson's Theatre, was witnessed by some 300 visitors on Wednesday evening.

Thursday, September 24, was given up to various expeditions about the city, and after luncheon the entire party went for a three-hour sail on Lake Michigan, refreshments being served during the trip.

The annual banquet was held at the Hotel Pfister at 8 o'clock on Thursday evening. Mr. William J. Lloyd was introduced as toastmaster. Vocal selections were rendered by Miss Bessie O'Brien, of Chicago, and City Attorney Carl Runge was introduced, making a brief address in which he thanked the telegraphers for their visit to Milwaukee. Following this there were short addresses by Colonel W. B. Wilson, and by Senator W. C. Burton, of New York, who spoke on "The Right Arm of Commerce." Mr. William O. Maver, Jr., of New York, responded to the toast "Wireless Echoes." Mayor Cochrane, of Montreal, was the next speaker, and Mr. L. B. McFarland, of Montreal, a former president of the association, followed with a brief address. Addresses were also made by Messrs. H. A. Tuttle, of Minneapolis; M. J. O'Leary, of New York; S. A. Duncan, of Atlanta, Ga., and Henry W. Pope, of New York.

The morning of September 25 was given up to a trolley ride to White Fish Bay, on the shore of Lake Michigan. Short addresses were made and the party returned at 2.30 P. M., when the Milwaukee festivities were at an end.

Annual Report of the Meridan Railroad Company.

The annual report of the Meridan Electric Railroad Company, which is owned by the New York, New Haven & Hartford Railroad Company, shows that during the past fiscal year cars were run an aggregate of 701,424 miles. The number of passengers carried was 3,470,480, and the number of paying passengers per mile of main track operated was 136,016. The gross earnings from operation were $149,469, and the operating expenses were $94,588, leaving the net earnings from operation $54,880. The deduction from the income includes interest payments aggregating $33,533. The total deficit for the fiscal year ending June 30, 1903, was $3,219 as against $15,601 for the previous year. Various additions to the equipment and permanent plant were made last year.

Professor Ayrton to Lecture before the New York Electrical Society.

Professor W. E. Ayrton, of the Central Technical College, London, will lecture before the New York Electrical Society, in the lecture room of the American Institute, 19 West Forty-fourth street, New York city, Monday, October 19, at 8 P. M. The subject of the evening will be "An Informal Talk on Some Electrical Measuring Instruments and Recent Use of Them."

Twenty-first Annual Meeting of the Street Railway Association of the State of New York.

Held at the City Hall in the City of Syracuse, N. Y., October 6 and 7, 1903.

THE meeting was called to order by Mr. G. Tracy Rogers, president of the association, at 10.35 A. M.

The secretary, Mr. Henry A. Robinson, called the roll, and the minutes of the preceding meeting, as printed, were approved.

Mayor Jay B. Kline, of Syracuse, was introduced, who welcomed the attendants after which President G. Tracy Rogers delivered his annual address.

The thanks of the convention was extended to the president for his very sound, able and instructive address.

Secretary Robinson read the report of the executive committee, and the special minutes.

The treasurer's report was read by Mr. Robinson, and this was accepted and approved.

The secretary read a communication from Professor George F. Comfort, inviting the members of the association to visit the Museum of Fine Arts, and another from the Central New York Telephone and Telegraph Company, tendering to the association the use of its service during the convention.

The first paper was read by Mr. James E. Duffy, Syracuse, N. Y., on "Transfers, Their Use and Abuse."

Mr. Duffy's paper detailed the condition of the transfer system in the city of Syracuse, and no claim was made that the conditions enumerated and met with would be applicable to any other locality. Whenever it is possible, it should be the duty of the manager, in routing lines, to so arrange them that as large a percentage of his patrons should have the benefit of a continuous passage as is possible from the standpoint of economical operation. There is no part of the successful operation of a street railway that has caused the management more thought and worry than the adoption of a transfer system that would prove satisfactory to its patrons and not leave loopholes that could be taken advantage of by dishonest people. The more attractive riding on street cars becomes, the larger will be the proportion of the riding population, and managers are to-day providing parks, pleasure resorts, etc., with beautiful cars, and all manner of transfer privileges, to attract passenger traffic. The liberal giving of transfers has to a large extent aided in increasing the business of the system with which the writer is connected. The author concludes that the transfer has come to stay, and that companies, while desiring to be as liberal as is consistent with good business policy, must adopt such measures as will prevent them from being imposed upon too generally.

Mr. W. B. Rockwell, of Syracuse, N. Y., took exception to the statement that the transfer had come to stay. It is the most burdensome thing that has been imposed upon railroad companies. He would rather give the passengers a four-cent fare, and abolish the transfers altogether.

Mr. W. W. Cole, Elmira, N. Y., thought the transfer had effected an increase of riding in those cities where the transfer was inaugurated. The transfer was not entirely an evil. The evil comes from the abuse and improper handling of them. If the misuse of transfers could be done away with, he thought there was no question that their use would lead up to a great increase in receipts.

Mr. T. J. Nicholl, Rochester, said there should be some action taken in the way of standardizing transfers, although he could see difficulties which would come up in that respect, because all cities are not laid out the same and would require different forms of transfers; but at the same time he thought there might be something done to educate the people to the use of a certain form of transfer, so that there would be no mistake, and a conductor going from one road to another would understand it easily without receiving fresh instructions.

Mr. Thomas E. Mitten, Buffalo, said he used the transfers as a method of building up the newer districts, and where there is the issue of a transfer upon a transfer, if that is confined to pleasure travel, he did not think its effect upon the earnings would become very detrimental.

Mr. Orin W. Root, New York, stated during the discussion his road was using on the average about 550,000 transfers a day.

Dr. J. J. Moorehead, New York, read a paper entitled "Methods of Discovering Fraudulent Claims for Injury."

Dr. Moorehead's paper enumerated a number of instances of the claims and statements which impostors make in attempting to secure damages for minor accidents. Claimants, he said, were divided into three classes—honest, partly honest and shammers. He also showed the ridiculous fashion in which all manner of diseases was traced to accidents incident to car travel, and the many times which these troubles, upon proper examination, had been distinctly traceable to other causes.

Mr. Don R. Almy, New York, mentioned several cases wherein the value of a physical examination of a claimant for damages was very evident, and stated that in his opinion there was no one element in the investigation of an accident which is so valuable.

This paper was followed by one on a similar topic, entitled "Physical Examination in Accident Cases," by Mr. W. A. Dibbs, of New York.

Mr. Dibbs dwelt strongly upon the great practical value of physical examinations. Too often, he said, the physician who happens to have charge of the case, either from a superfluous sentimentality or from a spirit of charlatanism, takes up the case both as an adviser and as a physician. In cases of this kind the only thing to do is to get a thoroughly reliable medical examiner to go into the case from the company's standpoint. He cited many instances of claims for damages which, upon examination, proved to be entirely without ground.

This paper was briefly discussed by Messrs. Rogers, Danforth, Allen, Smith and the author.

A paper on "Hydraulics in Connection with Street Railway Operation," was read by Mr. C. E. Parsons, of Glens Falls.

Mr. Parsons called attention to the necessity of developing hydraulic plants because of the demand for cheap transportation by electric railway systems. He took the new hydroelectric development at Spier's Falls, on the Hudson river, as a typical example of the important part in the operation of street railways which a hydroelectric plant may take. Six different railway systems are located within a radius of forty-five miles of this plant. Three of these are now using power from Spier's Falls and Mechanicsville, a plant in the same territory. The railroads are operated by means of transmission lines carrying high-tension currents to substations, where the current is stepped down and transformed by rotaries for

operating the lines. He detailed the question to be decided in laying out water power plants, as to the size of the units—both wheels and generators. The question of the building of the dam and the protection of the canal and forebay was also taken up, and considerable detail given to the question of the governing of the hydroelectric plant. The switchboard is another part of the system which needs careful study, and should be modern in every respect, in order that any possible chance of shutdown may be minimized.

This paper was discussed briefly by Messrs. Pardee, Clark, Mitten and Rogers. In reply to a question as to the distribution of pole lines and the labeling of poles carrying high-tension conductors, Mr. Parsons said that all high-tension wires were labeled dangerous where they passed through villages. Usually where it is twenty or thirty thousand volts the danger signal is put up.

On motion, the meeting was adjourned until 2.30 P. M.

TUESDAY AFTERNOON SESSION.

The first paper to be read was by Mr. T. W. Wilson, Buffalo, on "Track Construction and Maintenance."

The track upon which all the traffic is to be carried is one of the most essential parts of a railway. The author states, however, that the importance of the track and trackwork, in relation to the operation of the railway, and the proportion which the maintenance of track bears to the total operating expense, does not seem to be fully recognized by street railway officials. Mr. Wilson detailed the effects of operation with several forms of rail, and stated that the practical solution of the rail question would seem to be the use of nine-inch Trilby-type in the busiest thoroughfares of large cities, where the trucking is heavy; the grooved girder rail in quieter streets and those districts which, by reason of architectural construction, have been fixed as residential districts; and tee rails in smaller towns and cities and in the suburbs of large cities. Besides the shape of the lip of the girder rail there are two other important points to be carefully considered—the width of base and the depth of groove. The base on a nine-inch girder should not be less than six inches. The depth of groove should not be less than one and one-quarter inches. With the use of a concrete roadbed the wear upon the head of the rail is undoubtedly greater than with a flexible roadbed, and every one-thirty-second inch of increased depth means a longer life for the track. With the advent of the welded joint has come a great decrease in maintenance. The question of ties, roadbed and paving costs, construction and maintenance, were all thoroughly taken up and presented in a concise and readily understood manner.

Replying to a question by Mr. Cole, Mr. Wilson stated that he allowed cement grading to set for seventy-two hours before beginning to run cars over it.

Mr. R. E. Danforth spoke of the use of a "Tee" rail in small towns where there was little vehicular traffic and of the difficulty from snow and ice which has been experienced with the use of a grooved rail in Rochester.

Mr. Lewis, Schenectady, said the question of track construction is becoming very important. It has not had attached to it the importance in the past that it should have had; the necessity of having a better roadbed than has been had in very many instances is being recognized. Concrete construction in paved streets is absolutely essential, for this reason. In open track work, where the joints can easily be got to at any time of the year, flexibility is correct theoretically and practically; but when it is not possible to get at the joints a construction must be used which will make the joints practically indestructible. If a road is so small that it can not afford to put in electric or welded joints, it should use the very best type of mechanical joint, such as a bridge joint of some kind. He thought that other railway engineering associations should take up the question of track construction and give it careful attention.

His company is building some road from Troy to Schenectady, and nowhere is it putting less than a foot of ballast under the ties. On the Albany road it is putting in a foot of crushed stone. The conditions of the traffic warrant it, and the maintenance will be sufficiently less to justify it. On its other interurban proposition it is putting in a foot of gravel, as good as it can get.

Mr. M. A. Starrett, New York, spoke of the use of a proper wheel flange with a grooved rail as a self-cleaning proposition, and stated that this was found successful in New York city operation.

Mr. C. L. Allen described the work which had been done on the Utica & Mohawk Valley Railway, ninety miles out of the 114 of which runs over a private right of way. Many difficulties in the way of drainage had been encountered. On the uphill side of the roadway are constructed two ditches; one near the line of the right of way, just within the right of way, which receives the water that comes from the hillside; and from this outer ditch it is conducted to and through and under the roadbed and under the track structure. About four and one-half feet outside of the end of the ties on the hillside is constructed still another ditch, which gathers what water falls on the right of way and would overflow the outer ditch.

The question of drainage structures beneath the roadbed is one with which has been taken a great deal of pains. Culverts throughout are built of concrete, and are sufficient to take care of all the drainage. The roadbed is made of the excavated material which has been found in the cuts. On top of this roadbed is placed eight inches of gravel or crushed stone ballast. Upon the crushed stone ballast is laid oak or long-leaf yellow pine ties, spaced from eighteen inches to two feet centres, depending upon their proximity to joints. The rail used has been the American standard eighty-pound tee rail, in thirty-foot lengths, and supported by one or the other of two types of iron joints—the Webber and the continuous joint. The greater portion of this road has been in operation something over a year. The cost of maintenance has varied as the quantity of the gravel under the track structure has varied. He believes that if he had the roadbed to build over again, instead of spending the labor and energy in placing the gravel which had been found and which has been accessible to the work trains, it would pay to put broken stone under the track structure. The first cost of crushed stone would be perhaps twenty-five per cent greater, but the cost of maintenance would be considerably less.

The paper was further discussed by Messrs. Mather, Nicholl, Wilcoxen, Wilson, Rockwell Lewis and Pearsall on the compositive merits of different weights and lengths of rail, and on the subject of ties and tile conduit for drainage purposes.

The president then called upon F. J. Pearsall, of New York, to open the discussion of the Railway Young Men's Christian Association work.

He said that the way a man spends his time when off duty has a direct relation to the efficiency of his service when on duty, and a significant thing is a recognition on the part of employers that their full duty is not done when the employé is given his wages.

It was thirty-one years ago that the first Railroad Young Men's Christian Association was organized, and that was in Cleveland. The growth of the organi-

zation in the last ten years has been by far greater than its growth during the first twenty years. Now after close contact with the kind of work that the Railroad Young Men's Christian Association has done through these years, the managers are giving their hearty cooperation in extending these organizations among their men, more than ever before, because the organization is better understood.

At the present time, after this thirty-one years of effort, it is rather significant that the organization possesses a membership of sixty-two thousand railroad men. It owns in buildings and real estate property amounting to $1,250,000.

Mr. T. J. Nicholl described the formation of the association work in Rochester, and said that between five and six thousand dollars had been spent in fixing up the rooms. The Young Men's Christian Association had been a valuable ally in creating a healthy moral tone and he was heartily in favor of it.

In closing the discussion on this topic, Mr. Pearsall said that he hoped that the support which steam railroad managers had given this movement would be emulated by electric street railway men all over the United States.

Mr. Nicholl moved that the matter be referred to the executive committee to take it into consideration and under investigation through the proper channels and make recommendation as to what should be done at another meeting. Carried.

Mr. J. B. Storer, Syracuse, read a paper entitled "Power Transmission for Interurban Lines."

Mr. Storer compared the losses in the transmission circuit—including the generator and substation apparatus—with the losses in the locomotive on the regular steam road. In considering possible improvements that may be made in the electrical system, as now used on interurban lines, the separate sources of loss must be considered independently to see where and how they may be decreased. The question of frequency for railway circuits is considered, under existing conditions, not so much as what may be the best for the purpose, as by conditions imposed by something which may be quite at variance with what is considered strict railway practice. There would be greater reliability of operation on a system with two complete lines of No. 6 wire, than on one having one line of No. 3 wire, and the cost would be practically the same.

Replying to an enquiry from Mr. Barnes as to the reason for labeling a pole carrying a high-tension conductor, Mr. Storer said that if a transmitting line is operating successfully he saw no reason why the pole should be labeled "Dangerous" with a 20,000-volt circuit any more than with a 2,200. The general conditions, of course, are such that if a high-voltage circuit drops on a cross-arm or on a pole, it must be noticed, because it generally sets fire to the pole or the cross-arm and begins to burn it up. But the amount of leakage that would come from an ordinary pole he did not think would be sufficient to injure any person. It is more with the idea of keeping people away from it and impressing them that it is not safe to throw wires across transmitting lines than it is from any actual danger of the operating line itself.

Mr. Danforth asked Mr. Storer concerning his statement or recommendation of six wires on single-pole lines, for instance, in preference to three heavy wires, in giving more reasonable, proper or continued service. In case of the breaking of an insulator on one circuit, or the breaking down of the insulation in any way, or a wire dropping off from the insulation upon a cross line and the cross line may be burned off, and very frequently the pole is burned to the ground. Would this endanger the other circuit?

Mr. Storer replied that it certainly endangers it, but in general the damage is not carried that far before it is discovered that one circuit is in that condition. The ground detector should enable one to know that there is a grounding of one wire, and that circuit should be thrown out of service at once and the service put on the idle line before the damage could have reached any such serious stage as a person operating a system with one line would be forced into on account of the necessity of keeping the cars moving. With merely one transmission line the cars must be kept moving and the line kept in service, whereas with duplicate lines one could detect it almost instantly and could take advantage of the ground detector and transfer the pressure over to the idle circuit and let the defective circuit remain idle.

Mr. Pardee enquired whether any one had any experience with municipal interference with high-voltage lines near highways.

Mr. Allen stated that his company has a transmission line operating at 22,000 volts, and of about thirty-one miles of that line 1,000 feet is in a street in a village of about twelve hundred inhabitants. A resident on that street made a complaint to the State Board of Health, claiming that they were operating a line at 22,000 volts pressure over and above his sidewalk, and that he thought it was dangerous. That communication was referred to the board of Railroad Commissioners, and the matter is now being held without determination. He knew of one situation on this line now, in a city of 25,000 inhabitants, where a transmission line of 16,000 volts is being held up awaiting the determination of the State Board of Railroad Commissioners in this matter.

Mr. Barnes said the question should receive the serious consideration of the convention. When poles are set through the streets and labeled "Dangerous," the public has a right to believe that they are so; and if they are not dangerous the public should be informed and not be mislead into believing that they are dangerous.

Mr. Brady said this question of high voltage is one that immediately affects the matter of insurance. The Board of Underwriters presented some resolution on the subject at their last meeting, and which was held up for the time being, suggesting the restriction of these high-voltage transmission lines to a certain distance from buildings. That matter is pending at the present time before the National Board of Underwriters. It would not surprise him to see an effort made to have legislation enacted that would be very detrimental to the transmission lines where high voltage is being used, and, inasmuch as the railroad business is developing so fast, that would be very bad.

Mr. Storer, during the discussion, referred to a conversation that he had some time ago with Professor Ryan, of Cornell University, who had been conducting some experiments in connection with the protection of transformers and high voltages, and he ventured the prediction that in a lifetime one would see power transmission circuits operated at not less than 500,000 volts.

He thought that any steps that the legislature or the underwriters may take with reference to transmission lines and regulations as to their position and construction should be taken with a great deal of care, for if it is done unwisely it will certainly restrict transmission line construction and the distribution of power to such an extent as to be very detrimental to all railroad interests.

Mr. Barnes said that he thought what Mr. Brady suggested was so: that the legislature may be called on to take some steps to prevent a danger which perhaps does not exist, and he thought the associa-

tion can do a great deal in heading off unnecessary legislation in that direction by taking some initiative action in the matter. Without expressing an opinion, there is a great question whether the current transmitted at that voltage in the way it is at present is a danger to the community.

Mr. Barnes suggested that a committee be appointed by the convention that shall undertake an investigation of the conditions as they exist to-day, and report at the next convention.

Mr. E. F. Peck, Schenectady, moved that the association appoint a committee of three to act jointly with the American Institute of Electrical Engineers and the National Board of Underwriters, the committee to be appointed by the chair, and report later. The motion was seconded and carried.

The president appointed as members of the nominating committee Messrs. T. E. Mitten, H. A. Nicholl and J. T. Smith, and the convention adjourned until 9.30 A. M. Wednesday.

WEDNESDAY MORNING SESSION.

The first paper to be read Wednesday morning was entitled "Despatcher's Duties and Electric Signals," by Orlando W. Hart.

Electric railways, in but few instances, have not the advantage of manned stations along the line, with telegraphic communication with the despatcher's office, as is the case with steam roads. They are also at a disadvantage owing to the large number of operating units and the fast schedules maintained on their urban and interurban divisions. Some system of signals should be installed and maintained, enabling the despatcher to set an order signal at any desired point or telephone station at any point along the line, and to receive an answer back recording same, together with the date, hour and minute of the operation, on an instrument in the office provided for the purpose. All movements should be simple and automatic in their action, and positive in their reply, but in no case should the answer back be received until after the signal is at full danger and locked in that position. Only one signal should be operated at a time, but so arranged that in case of the setting of two or more signals, two or more movements of the office instruments should be made and their replies recorded.

The discussion on Mr. Hart's paper was postponed and Mr. Barnes's paper on "Steam Railroad Crossings; or Right-Angle Crossing of Electric Lines," was read by Mr. Clark.

Mr. Barnes opened his paper with the statement that the danger caused by railroad operation at grade crossings of streets or highways is directly proportionate to the number of trains operated on railroads and the amount of pedestrian and vehicular traffic on the street or highway. The board of railroad commissioners, acting under the authority conferred upon it by the laws of the state, caused an examination to be made of every grade crossing of steam and electric railroads in the state. Realizing the liability of accident at these points, and that the most perfect rules, as rigidly enforced as possible, were not sufficient protection, even where gates were maintained, additional protection has been ordered. In all cases where the traffic on the steam and electric roads warranted, the commission has ordered derail switches operated from a tower. The ideal protection at the crossings of steam and electric tracks consists of derail switches in the electric tracks, interlocked with home and distance signals on the steam road, arranged so that after a train has reached the home signal, the derail can not set for an electric car to proceed until after the train has passed the crossing.

Mr. Barnes replied briefly to several questions and the president called for a discussion of the subject, "The Advantages and Disadvantages of Oil Tail-Lights for Interurban Cars."

Mr. Barnes said that a number of accidents have occurred in the state which have been caused by cars breaking down, being derailed, or stopping from other causes, and losing their supply of electric current, leaving them in darkness, and cars following have run into the rear end of them, and the number of those was so great that the board of Railroad Commissioners has suggested to the managers of the roads the plan followed by steam roads, of having an oil light or signal on the rear end of each car, and especially on suburban on interurban cars, and not only on those operating at high speed, because we have had a number of accidents of that character occurring on what might be termed ordinary interurban or suburban roads.

The next topic was "Street Car Controllers, Their Proper and Improper Operation," which was discussed briefly by Messrs. Barnes and Cole.

This was followed by a discussion on "Interurban Service." This topic was divided under three heads—*a*—"Standard Equipment" was opened by Mr. C. L. Allen, of Utica, who said, in part:

"Whether it is possible to adopt a standard car for interurban service is a question. Each system or each road has some peculiar condition that must be dealt with. As to the electric equipment on a standard car for interurban service, I hardly think it is possible to attain that point. There are so many local conditions controlling: grades, frequent stops, and the alignment of the road should determine the question of the size of equipment to be placed under an interurban car. As to the trucks, I think interurban practice has settled down practically to three types of trucks for interurban service: first, the master car builders' truck which has come into general use; second, the large, heavy truck, as built by the Brill Company and sold for heavy elevated service and for heavy interurban service; and practically the same type of truck which is built by the Peckham Company. When we take up the question of trucks the question of wheels comes to us. The question whether a chilled wheel or a steel wheel is the proper thing to use on interurban cars from an economical standpoint is one that should be investigated very carefully. On the question of safety, I think general practice has shown that there is but one wheel to adopt, namely, the steel wheel. The question of whether the steel wheel is economical or not depends very largely upon the dimensions of the flange and tread; the greater the depth of the flange and its width the greater the life will be of that wheel. What I have said of the dimensions of the steel wheel is true also of the chilled wheel. Steel wheels that by reason of local conditions have to be designed with shallow treads and with shallow flanges will not, of necessity, give the service that a wheel that has the large tread and the deep flange will give. I think the consideration of safety alone should control the question of wheels."

Mr. Rockwell asked Mr. Allen whether he considered an inch flange sufficient for a fifty-mile-an-hour car.

Mr. Allen said that he had operated cars having a seven-eighths inch flange and a thickness of three-quarters of an inch at speeds up to fifty miles an hour. His company has adopted on the Utica & Mohawk Valley the standard master car builders' wheel with this exception, in the width of the tread. The flanges are one and one-eighth inches in depth, and one and one-eighth inches in thickness, and the tread is two and three-quarters inches. Its special work has been designed and built for that. It has operated chilled and steel wheels over old girder rail sections which had originally only a depth of one inch from the head, which was difficult and which beyond doubt was expensive as far as the item of power was concerned, because the car was riding practically on the face of the flange. But since that time it has been operating those wheels and not confining them to any one piece of track, but has operated them all over the whole system.

"Car Despatching" was the next subhead under the title of "Interurban Service." Mr. Wilcoxen, of Rochester, responded to this.

Mr. Wilcoxen compared the advantages and disadvantages of the telegraph, as used in the steam road system of despatching; the electric block

signal system, and the practice of using the telephone. The Rochester & Sodus Bay division of the Rochester Railway system has been in operation for four years, using a telephone system for despatching trains. This is a single-track line extending from Rochester to Sodus Point, a distance of forty miles, thirteen of which is on private right of way, with sidings every mile, a majority of these being used only for freight and meeting points when trains become late. Telephones are in agencies at each village, in substations and on each car, and plugging boxes are provided at every siding. The despatcher is located at Rochester, the western terminus of the division. The train crews receive written orders, issued in triplicate, the motorman, conductor and despatcher retaining copies. The paper describes in detail the system of despatching, and the author states that the method has been found to work very satisfactorily.

The discussion on this paper was taken up in connection with Mr. Hart's paper.

Mr. Barnes said that nine-tenths of the collisions occurring on electric railroads to-day is the direct result of defects in train despatching. It is a branch of the operation which should be improved for the protection of the public and for the financial interests of the companies. A serious question, and one which should receive proper consideration, is whether it is advisable to give trains operating in either direction a superior right on electric roads. In deciding that question the class of employés on electric railroads must be taken into consideration. While that is the plan employed by steam roads, with their experienced engineers and conductors and train crews, it is a question whether to-day accidents would not be lessened by not giving either direction trains superior rights. The standardizing of equipment is a good thing, but the standardizing of train despatching is more important and will prevent more accidents.

Mr. C. L. Allen moved that a committee be appointed by the president to take up the question of train despatching and see if some system of train despatching can not be adopted by the association, and that the committee be appointed by the chair. The motion was seconded by Mr. Cole and carried.

Upon discussion as to the appointing of this committee conflicting with the already existing Rules Committee, Mr. Allen amended his motion and the matter was referred to the Rules Committee.

The next topic was "Standard Methods of Fare Collection and Ticket Taking."

This paper was not discussed and the next subject taken up was "Extra Freight and Baggage Service on Interurban Lines." The first, "Traffic Arrangement with Steam Roads and Boats," was not responded to as it had been difficult to find a road in the state that had any extensive arrangements of that kind. "Traffic Arrangements with Other Interurban Lines" was responded to by Mr. Nicholl, of Rochester.

Mr. T. J. Nicholl, of Rochester, opened the discussion on the topic "Traffic Arrangements with Other Interurban Lines." He said his company had quite a number of contracts with other interurban lines or lines entering the city, and possibly the form of contract is a little peculiar. The company's policy has been to welcome any reliable promoters who were really going to build a road, to welcome them to the city and to the use of its tracks under proper restrictions. One of the restrictions is that it retains the right to change the crews at the point of junction. That is, although it generally allows the new company crews to come into the city, at the same time it retains the right to put its own crews on their cars; and the crews of the entering company have to be under its orders and under its control. The incoming roads, in consideration that they are allowed to do such traffic as they wish on his company's streets, are required to pay the gross earnings on that line per car-mile. They can pick up passengers or drop them off anywhere, or do a city business on the street on which they come in, but if the car earnings on that line are twenty cents it requires them to pay it twenty cents for the use of track and power. They supply their own cars and provide their own men to run the cars and indemnify it from accidents.

The last paper, "Freight Development by Interurban Roads," on the programme was contributed by Mr. E. F. Seixas, of St. Catharines, Ontario. Mr. Seixas was not present, and his paper was received and spread on the minutes.

This paper related the experience of the Niagara, St. Catharines & Toronto Railway in carrying freight. The gross annual freight earnings of the line prior to 1900—at which time it was a steam road—were less than $20,000, and the freight handled was confined to low classes of car-loads, such as coal, this, in fact, being the principal traffic handled. Very little attention was paid to the higher-class traffic, such as package merchandise, and it was not until 1901 that any marked increase was shown. During 1899 and 1900 the system was converted to electricity, the first electric car running July 19, 1900. The revenue for the year ending August 31, 1903, shows an earning of 120 per cent more than in 1900, and an operating expense of fifty-two per cent, as against a previous loss. On the whole, freight business will pay interurban roads if confined to the higher classes of traffic and particular attention is paid to despatch and accommodation to the public.

The president appointed a committee of three to act with the National Underwriters and the Electric Light Association, consisting of Mr. S. R. Storer, of Syracuse, Mr. W. F. Rockwell and Mr. R. E. Danforth.

Mr. Connette, of the Committee on Rules, reported a recommendation that the association adopt the report that was recently adopted by the American Street Railway Association, because it differed but very little from the one which is already in vogue. As to rules governing interurban service, it was suggested that action be deferred until the State Board of Railroad Commissioners can have an opportunity to examine it and pass upon it, and it was recommended, therefore, that the association adopt the report so far as the rules governing conductors and motormen are concerned, and that the recommendations governing interurban service be postponed until the State Board of Railroad Commissioners can have a chance to examine it and pass upon it, and that the committee make its final report on the interurban service rules at the next meeting.

Mr. Allen moved that the report of the Committee on Rules be accepted, and that the committee be continued for another year.

The nominating committee submitted in nomination for officers and members of the executive committee of the association for the coming year, the following:

For president, Mr. G. Tracy Rogers, of Binghamton, N. Y.

For first vice-president, Mr. E. G. Connette, of Syracuse, N. Y.

For second vice-president, Mr. Addison B. Colvin, of Glens Falls, N. Y.

For secretary and treasurer, Mr. W. W. Cole, of Elmira.

For members of the executive committee: Mr. C. Loomis Allen, of Utica; Mr. B. B. Nostrand, Jr., of Peekskill, and Mr. W. H. Pouch, of Newburgh.

Mr. Rogers thanked the nominating committee for again tendering him the honored position as president, but said he was compelled to decline, because of force of business circumstances.

In moving the acceptance of Mr. Rogers's declination, Mr. W. Caryl Ely paid a splendid tribute to the work which Mr. Rogers had done and placing in nomination Mr. E. G. Connette, of Syracuse.

Although Mr. Connette declined the honor, the secretary was ordered to cast one ballot, and Mr. Connette was declared elected.

The secretary was empowered to cast one ballot for A. B. Colvin, of Glens Falls, as first vice-president; for Mr. Heins as second vice-president; for Mr. W. W. Cole as secretary and treasurer, and for Mr. C. Loomis Allen, B. B. Nostrand, Jr., and W. H. Pouch as members of the executive committee.

A formal expression of thanks and gratitude was extended to the local committee of Syracuse which had so generously arranged for the splendid and hospitable entertainment.

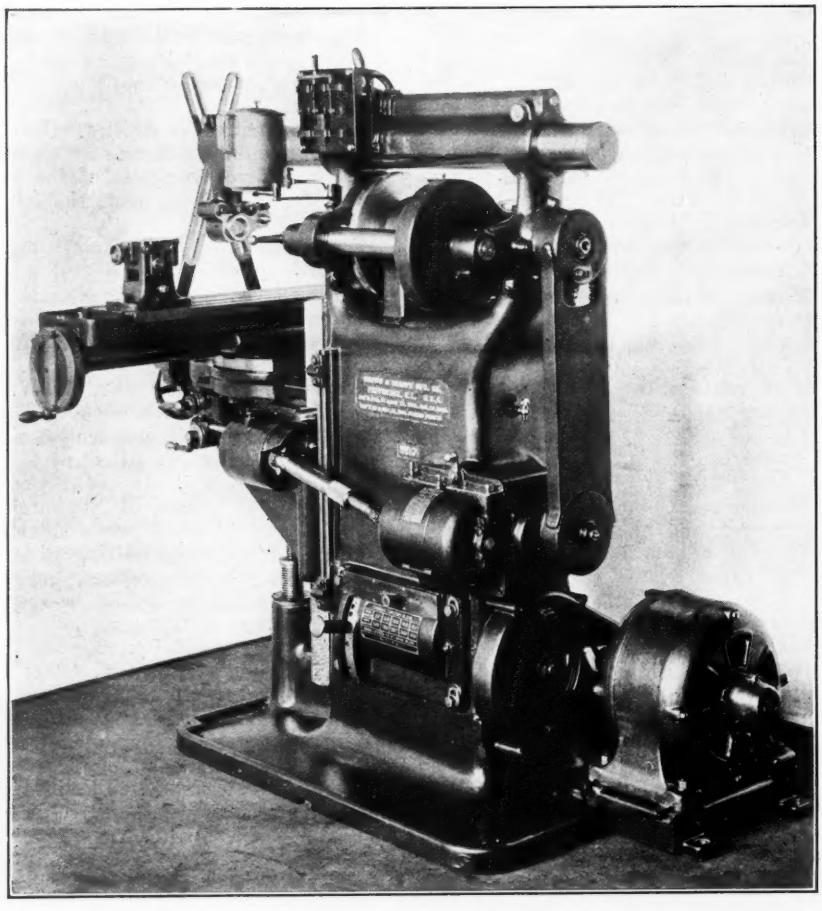
A committee was appointed to draft suitable resolutions of recognition of the services rendered by the various officers of the association, particularly Mr. Henry A. Robinson, the retiring secretary-treasurer, after which the officers went into executive session.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Motor-Driven Milling Machine.

The accompanying illustration shows the No. 3 universal milling machine built by the Brown & Sharpe Manufacturing Company, Providence, R. I. This machine, in addition to being motor driven, possesses several distinctive features which make it of great value in machine shop work. The spindle is of crucible steel. The bearings are ground and lapped, and run in phosphor-bronze boxes which are provided with means of compensation for wear. The cone has four steps and is back-geared. Sixteen changes of speed direct are made, from 13 to 392 revolutions per minute. Eight reverse speeds are made, from 14 to 353 revolutions per minute. The speeds are made in geometrical progression.



MOTOR-DRIVEN MILLING MACHINE.

The overhanging rod is of solid steel, with both bearings clamped with one lever. The arbor support is equipped with a bronze bushing and adjustable centre. The table, including oil pans and channels, is fifty and one-quarter inches by ten inches. The working surface is forty-five and one-half inches by ten inches. There are three key slots five-eighths of an inch in width. The longitudinal feed, automatic in either direction, is twenty-eight inches. The transverse feed, automatic, is eight and one-half inches. The vertical feed is nineteen inches. A quick return is operated by internal gear. The power feed can be used with table set to fifty degrees either side of zero.

Two supporting gears are driven by chain. There are twelve feed changes, varying in geometrical progression from 0.005 to 0.153 inch to one revolution of spindle. The feed tripping mechanism is of the double plunger type and can be set to prevent throwing in of the wrong clutch. The index has a swing of twelve inches in diameter and takes twenty-six inches in length. The vise swivels and has a graduated base. The jaws are hardened and are six and one-eighth inches wide, one and nine-sixteenths inches deep, and open three and five-eighths inches.

The countershaft is supplied with three friction pulleys—two twelve inches in diameter and one fourteen inches in diameter, using three and one-half inch and four-inch beams.

The net weight of the machine is 3,930 pounds.

The machine shown in the accompanying illustration was fitted up for the Mare Island Navy Yard, and is driven by an alternating-current motor connected with a variable speed changing mechanism by a Hans Renold chain, the speed mechanism being connected in the same manner to the machine spindle. The motor runs at constant speed, the feed changes being obtained by the simple manipulation of the sliding knob and lever shown at the lower part of the base.

There are sixteen spindle speeds, which are secured as follows: The locking pin of the lever shown at the left is first pulled out and the lever thrown down as far as it will go. The sliding knob is then unlatched and moved until it is over the column in the table in which the required spindle speed is given. The lever is then unlatched and moved up until the proper gears mesh, when the locking pin will drop into the correct hole.

The feed mechanism is driven from the spindle of the machine by chain and sprocket wheels, varying in geometrical progression as described above.

Seattle Water-Wheel Installation.

The city of Seattle municipal lighting and power plant has awarded the Pelton Water-Wheel Company, San Francisco, Cal., the contract for supplying water-wheels for its power-house. The main wheel units will be two in number, each direct-connected to a 1,200-kilowatt, 2,300-volt, sixty-cycle, three-phase, alternating-current, revolving-field generator. The wheel unit will operate under an effective head of about 550 feet and will have a capacity sufficient to develop fifty per cent overload in each generator. Two seventy-five-kilowatt, 125-volt, compound-wound, multipolar, direct-current generators will furnish exciting current. Each of these machines will be direct-connected to a Pelton wheel running at 550 revolution per minute. The transmission line into Seattle will be approximately forty miles long, and current will be stepped down to two-phase at 2,200 volts for city distribution for lighting, through constant current transformers.

A New Signal System for Electric Railways.

The accompanying illustrations show the details of a new two-line wire block system which is being placed on the market by the Uni Signal Company, 42 Osborne street, Cambridge, Mass. The standard equipment consists, for a complete block, of the following apparatus—two signal movements, two iron signal boxes, two double-acting trolley switches and two terminal boxes, each containing three

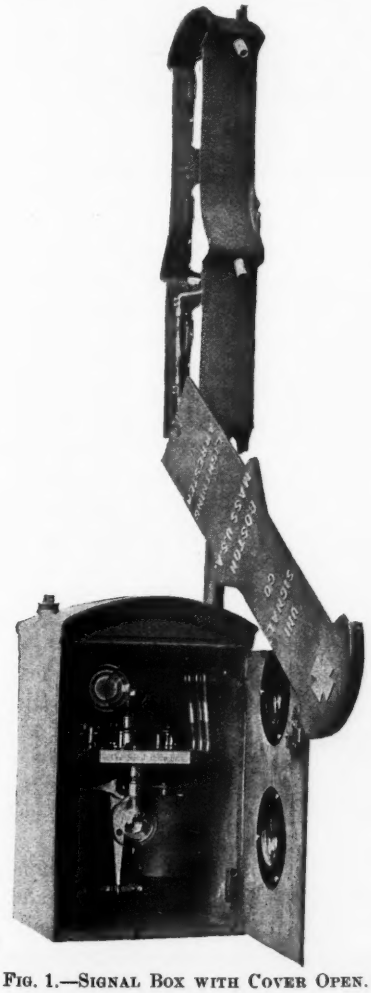


FIG. 1.—SIGNAL BOX WITH COVER OPEN.

Garton-Daniels 500-volt, direct-current, railway lightning arresters.

This system is stated by the manufacturer to be applicable to all electric railway systems, and is especially adapted for single-track trolley electric railways where it is desirable to protect any section of track from both a head or rear-end collision.

In installing the signaling apparatus a trolley switch is clamped to the trolley wire and supported by a span wire from the nearest pole, or by a bracket arm. This switch is placed at a point as near the bifurcation of the single section of track as practicable. On the next pole in advance to that supporting the trolley switch the signal box is placed. Directly above the signal box is installed the terminal box containing the lightning arresters. Connection between the signal box and the terminal box is made by a lined iron conduit pipe, one inch in diameter, of sufficient length to allow the terminal box to be among the cross-arms and the signal box at a clearing distance from passing cars, or as other conditions may determine.

The signal box is attached to the pole so as to show both the green and red signal lamps of the trolley switch or the entering end of the block. From the trolley switch are run two switch wires to the adjacent terminal box containing the lightning arresters, and which, in turn, connects with the signal box by heavy insulated rubber-covered wires. The two signal boxes are connected together through their respective terminal boxes by two signal line wires. Each signal box likewise has a permanent feed-wire connection with the trolley wire and one with the track. Thus six wires enter the terminal box. These wires are known, respectively, as lighting switch wire, extinguishing switch wire, lighting line wire, extinguishing line wire, permanent feed wire and ground wire. The same arrangement is installed at the leaving end of the block, which is the entering end if the block is entered from that direction.

In operation this system shows whether the section of track to the next turn-out is free or occupied by another car; also, if occupied, the direction in which the car has entered the block. A car, on entering a block station—usually a single track—has its trolley wheel run under an automatic trolley switch which lights a green lamp in the signal box directly in advance of the car, and also lights a red lamp wire in series with it in the signal box at the distant or leaving end of the block. On the car passing under the switch at the leaving end of a block, both lamps are extinguished. Where neither lamp is lighted the section contains no car. A car entering from the other end will, under normal conditions, do the same —that is, the signal is double-acting.

Fig. 1 shows the signal box with the cover open and also the manner of connection to the terminal box containing the lightning arresters. This is the apparatus required at each end of the block.

Fig. 2 shows the terminal box with the cover removed, exhibiting three Garton-Daniels 500-volt lightning arresters which are furnished with each terminal box. The heavy fuse wire in the leg to ground is seen at the lower left-hand side. The porcelain tubes where the wires enter the terminal box are also clearly shown, as

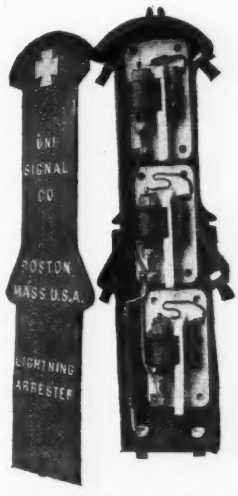


FIG. 2.—TERMINAL BOX WITH COVER REMOVED.

well as the lugs for attaching the box to the pole.

Fig. 1 shows the signal box with the door open and the movement in place. By turning a lock button in the back of the box and removing the enclosed fuses at the side of the movement, the entire signal movement can be removed from the box by a handle cast integral with the back plate. The green and red semaphore lenses can be seen in the hinged door of the terminal box.

The movement is shown in Fig. 3, show-

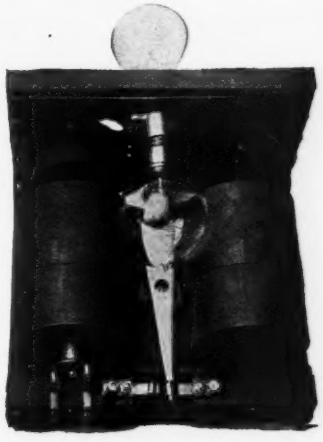


FIG. 3.—SHOWING THE THREE MAGNETS, SWITCH, LEVER BALANCE ARM, AND TWO SIGNAL LAMPS.

ing the three magnets, the switch, the aluminum lever and balance arm, and the two signal lamps. Two circuit-breaking contacts not in the illustration are located on the top slate. The third cir-

cuit-breaker contact is shown at the bottom of the left-hand magnet.

Fig. 4 shows the iron back plate with top and bottom slate. At the left-hand are shown the two fibre tubes enclosing the connection between the top and bottom slates. Resting at the left of the back plate is the ribbed iron resistance plate, and in front of the back plate is the aluminum lever and balance arm Standing at the right is the lighting magnet with its armature. Lying on its side at the left of the back slate is the extinguishing magnet with its two armatures.

The main body of the trolley switch is of malleable iron. The supporting frame is cast in one piece and holds all the operating parts of the switch. When the hood is placed in position contact is made between two flat springs and two brass plates at the top of the hood. The electrical features embodied in the apparatus

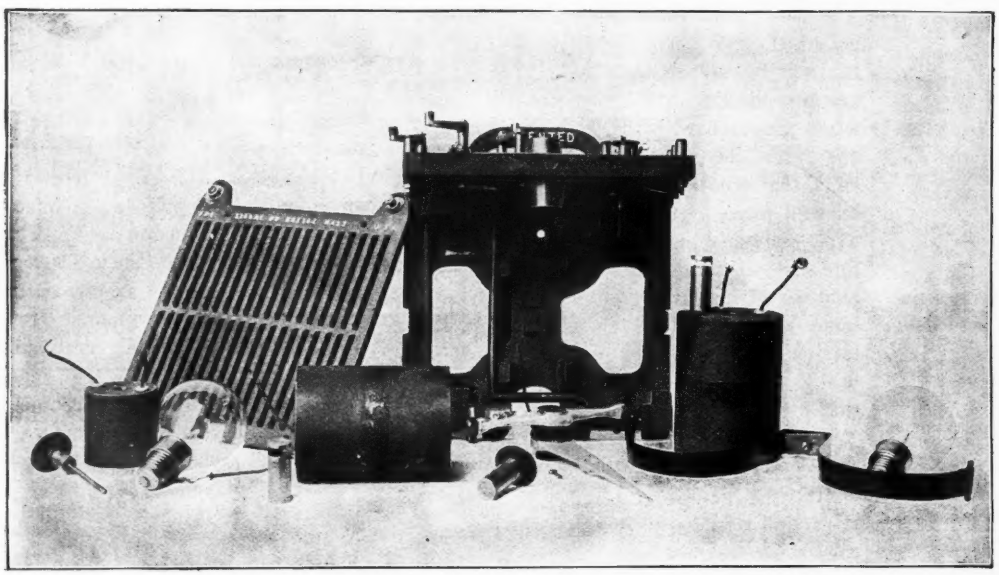


FIG. 4.—SHOWS IRON BACK PLATE WITH TOP AND BOTTOM SLATE.

are simple in design. The magnets are of the iron solenoid type and were adopted because their armatures could be internal and magnetic leakage thus obviated. The magnet coil is wound on a brass spool insulated by oiled silk, and is removed from the magnet by unscrewing the magnet end. The terminals are brought out through lava bushings. The magnets are tested against a 2,000-volt breakdown test.

In series with the red lamp is the locking magnet, which is energized as soon as any current passes through the red lamp. This holds the armature core against the locking magnet and at the same time a tail rod connected with the armature presses against the balance arm of the movement and prevents the lighting magnet from operating. The function performed is to prevent the extinguishing of the red lamp signal should a car attempt to enter a block with a red lamp set against it.

Triplex Blocks for Hoisting Service.

The accompanying illustrations show several typical Triplex hoisting blocks made by the Yale & Towne Manufacturing Company, 9 to 13 Murray street, New York city. Fig. 1 shows a Triplex block in an erecting shop. One man can pick up a heavy load in half a minute by means of this block and move it to the other end of the shop in a minute more. Fig. 2 shows a Triplex block serving the benches in a shop by means of overhead trolleys, Fig. 3 showing a Triplex block serving a heavy turret lathe by means of overhead trolleys.

The saving of time and labor effected by the Triplex block is accomplished by separating the suspending mechanism from the hoisting gear, so that the operator is not wasting the larger part of his effort in overcoming friction. The hoisting mechanism consists of a direct train of spur gears from the small pinion on the central shaft to the internal gear wheel cast within the main frame. The two intermediate gears between the pinion and the internal gear are carried on the circular frame or cage, and roll around within the internal gear, thus forming a sun-and-planet movement, giving the desired leverage.

The great advantages of the double arrangement of intermediate gears are balanced journal pressures, increased wearing surface, subdivision of strains, and an accurate equalizing of the load, resulting in diminishing friction and wear.

The frame carrying these intermediate gears is keyed fast to the hub of the hoist chain sheave, and the central pinion shaft is driven by the hand chain wheel, so that the power is transmitted from the hand chain to the load chain through a direct spur gear train of high efficiency. The sustaining mechanism at the hand chain end

FIG. 1.—TRIPLEX BLOCK IN AN ERECTING SHOP.

of the block (the left of Fig. 5), consists of a set of discs, one of which has external ratchet teeth engaging with a drop-forged pawl. The hand chain wheel is screwed upon the central spindle as shown, and clamps the discs tightly to the shaft in hoisting, or if the shaft tends to revolve under the pull of the load. The parts thus clamped together act as one, and the ratchets offer no resistance in hoisting. When the direction of the hand chain wheel is reversed in lowering, it unscrews, the ratchet disc being held by the pawl, and the load is lowered against the friction of the discs under control of the hand chain, the stoppage of which causes the discs to tighten and sustain the load perfectly.

Many important improvements have recently been incorporated in the Triplex blocks which permit of

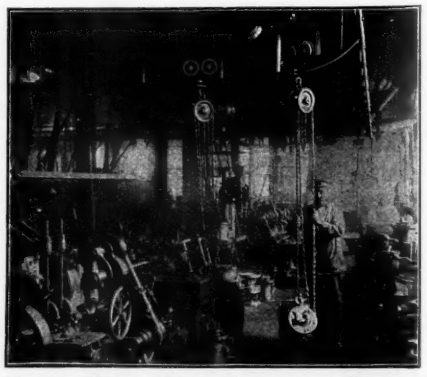


FIG. 2.—TRIPLEX BLOCK SERVING THE BENCHES IN A SHOP.

very easy and rapid lowering, with a spinning motion of the hand wheel. The friction discs never re-

quire adjustment and are positive in their action. The load automatically tightens the discs and takes up wear; it can not run down of itself, as the only result of such a tendency is

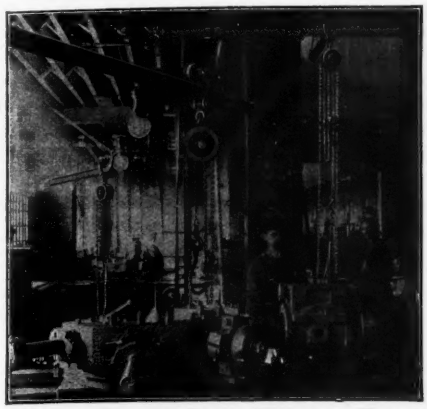


FIG. 3.—TRIPLEX BLOCK SERVING A HEAVY LATHE.

to further tighten the discs. To unlock the disc and start lowering easily, give the hand chain wheel a half turn in the direction for hoisting and then reverse quickly.

The trade name Triplex was selected because the block is triple-geared, having the equivalent of three parallel shafts connected by power multiplying gears, and giving nearly threefold the efficiency of its predecessors.

The United States Army has adopted the Triplex block for serving heavy ammunition in the coast defense magazines because of its safety and speed.

FIG. 4.—TRIPLEX HOISTING BLOCK.

In the twelve, sixteen and twenty-ton sizes an important advantage is their two independent hand chains, which may be worked both together or one at a time.

The full load may be raised by two men pulling on one hand chain, or at double speed by four men.

In like manner lowering may be effected at varying speeds by using either or both of the chains.

Light loads may be handled easily at higher speeds than with smaller blocks, because two men can work more freely at the separate hand chains, which are clear of the load and in the most convenient position for effective use.

These blocks are very compact and occupy little headroom. For use on hand cranes this is the most rapid and efficient and least expensive hoisting mechan-

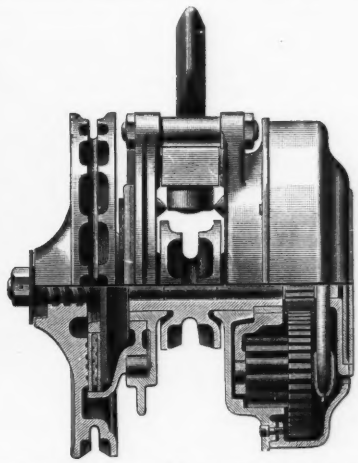


FIG. 5.—SUSTAINING MECHANISM OF TRIPLEX BLOCK.

ism yet devised; the speed in hoisting is from four to six times that of the ordinary worm-wheel construction.

Recent Illustrated Trade Literature.

The publishing department of the General Electric Company has recently issued to the trade a series of fliers and bulletins of more than ordinary interest.

Three fliers—Nos. 2114, 2116 and 2117—describe and illustrate, respectively, concentric light diffusers, meter jewels, and combined switch and enclosed fuse cutout for car lighting. A splendidly printed booklet, entitled "Core-Type Transformers," is a short treatise on the development of the core-type transformers of the General Electric Company. Another booklet in a handsome green cover, entitled "The Permanency of Transformer Insulation," gives a number of views of type H transformers and a study of the process of making transformer insulation. Supply catalogue No. 7583 details parts of U. S. trolleys, giving the dimensions and characteristics of every part of the union standard trolley. In addition to those already mentioned, bulletins for August and September Nos. 4334, 4335, 4336, 4337 and 4338 have been issued. Bulletin No. 4334 is an illustrated description of direct-driven continuous-current generators for lighting and power. Bulletin No. 4335 is an illustrated description of engine-driven revolving-field alternators. Bulletin No. 4336 is an illustrated description of isolated plant switchboards for continuous-current two-wire service. Bulletin No. 4337 describes and illustrates blower sets for air-blast transformers, and Bulletin No. 4338, power-factor indicators for balanced systems.

THE OHIO ELECTRIC LIGHT ASSOCIATION.

NINTH ANNUAL CONVENTION AT THE HOTEL CHITTENDEN, COLUMBUS, OHIO, OCTOBER 13, 14 AND 15.

The following programme was announced for the ninth annual convention of the Ohio Electric Light Association, held at the Hotel Chittenden, Columbus, Ohio, October 13, 14 and 15.

TUESDAY, OCTOBER 13, 10 A. M.

Roll call. Presentation of candidates. Reading of minutes of last meeting. President's address. Announcements. Executive session.

TUESDAY, OCTOBER 13, 2 P. M.

"Equipment and Boilers," Mr. W. D. Chester, Babcock & Wilcox Company, Pittsburg, Pa., followed by general discussion opened by Mr. D. S. Kohler, of the Columbus Edison Company, Columbus, Ohio.

Tuesday afternoon there was an entertainment for the visiting attendants.

WEDNESDAY, OCTOBER 14, 9.30 A. M.

"Engine Economy and Equipment," Mr. E. J. Bechtel, Toledo Railways Company, Toledo, Ohio. "Development in the Engine Room," Mr. J. H. Perkins, Consolidated Gas and Electric Company, Youngstown, Ohio. A paper was also contributed by Mr. W. F. Raber, Mansfield Electric Light and Power Company, Mansfield, Ohio. Mr. George Hayler, Van Wirt Gas, Electric Light and Power Company, Van Wirt, Ohio, contributed a paper on "Steam Records," and Mr. A. C. Blinn, Sandusky Gas and Electric Light Company, Sandusky, Ohio, contributed a paper on "The Value of Station Records." This was followed by a general discussion on engine room and station records.

WEDNESDAY, OCTOBER 14, 2 P. M.

A paper on "Distribution," by Mr. K. C. Randall, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. "Notes on Certain Three-Wire Systems," Charles Mosman, General Electric Company, Schenectady, N. Y. This was followed by an address on "The Municipal Code," by D. L. Gaskill, Greenville, Ohio.

In the evening a trip was made to the Ohio State University, by invitation of the faculty.

THURSDAY, OCTOBER 15, 10 A. M.

Paper on "The Combined Use of Direct and Alternating Currents for Central Stations," by Professor F. C. Caldwell, Ohio State University, Columbus, Ohio. "Methods and Means of Securing New Business," W. J. Hanley, General Electric Company, Cincinnati, Ohio.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CANADIAN WESTINGHOUSE COMPANY INCORPORATED—At a meeting held October 9, in Hamilton, Ontario, and presided over by Mr. George Westinghouse, the Canadian Westinghouse Company, Limited, was organized with a capital of $2,500,000. The new company is a consolidation of all the Westinghouse interests in Canada, which have heretofore been conducted individually.

LONDON-BRUSSELS TELEPHONE SYSTEM EXTENDED—The existing telephone system between London and Brussels is to be extended to Antwerp, Bruges, Charleroi, Ghent, Liege, Louvain, Malines, Mons, Namur, Ostend, Termonde and Verviers. Communication will also be opened between Birmingham, Brighton, Bristol, Cambridge, Cardiff, Derby, Ipswich, Norwich, Nottingham, Sheffield, Southampton, Leicester, Lowestoft, Newport and Yarmouth.

ELECTRICITY FOR AUSTRALIAN RAILWAYS—Plans are being considered for adopting electric traction on some of the railways in the state of Victoria, in the Australian Commonwealth, particularly on the suburban railway system of Melbourne. The possibilities of the proposed change from steam to electric traction have been the subject of discussion with the railway commissioners of the state for some time past. The matter has also come under the notice of the Victorian parliamentary standing committee on railways, and a subcommittee of that body has been appointed to make enquiries on the whole subject. The committee is now busily prosecuting its enquiries in Sydney, where a large scheme of conversion from steam to electric traction on the state tramways is nearing conclusion.

THE NEW YORK SUBWAY—Chief Engineer William Barclay Parsons, in a recent report upon the progress of the subway work to the rapid transit commissioners, shows that the work of excavation, including work at Fort George and the Harlem tunnel, is ninety-seven per cent completed and practically all of the three per cent incompleted work is at the two points just mentioned. Of the construction, seventy-five per cent is completed and installed. Fully three-quarters of the remaining twenty-five per cent is well in hand. The strike on the power-house has delayed work more than anything else. Tracks have been laid from Grand street to Twenty-third street, and ballasted from Twenty-third street to Thirty-third street. From Forty-seventh street to Sixty-fifth street the tracks are ready for cars.

GEORGIA POWER PLANT—The Winding Shoals Electric Power Company, recently incorporated at Buford, Ga., will install a 6,000-horse-power hydroelectric plant on the Chattahoochee river, four miles west of Buford. The plans contemplate the construction of a crib dam, for which an abundance of material can be secured in close proximity to the plant, as the location selected for the dam and power-house lies between high bluffs which are composed almost entirely of solid granite. The power-house will be of stone and concrete construction. The first equipment of wheels and generators will be for about 3,000 horse-power, ultimately increasing it to 6,000. Part of the power will be utilized by local factories in Buford, which is the largest leather manufacturing district in the South, and for the Atlanta, Buford and Gainesville Railway, for which surveys are now being made. The balance of the power will be transmitted to Atlanta and surrounding towns, the bulk of it being likely to be taken to Atlanta. The Electrical Equipment Company, Chicago, Ill., is preparing plans and specifications for the work.

NEW BRIDGE TRAFFIC PLAN TESTED—A fifty-four-minute test was made last week on the Brooklyn Bridge of what is known as the Poulson plan to relieve congestion of the trolley car patrons at the Manhattan terminal. Mr. Niels Poulson, who is president of the Hecla Iron Works, of Brooklyn, N. Y., and the inventor of the plan, was practically in charge of the test. The scheme of relief was to utilize all available space at the bridge entrance; to have a single-loop track at the extreme western end of the surface car terminal; to unload them in groups of five on the north track and to load them in groups of five on the south track, and to have no passengers board or leave the cars on the loop. At the beginning of the test, cars were started on the afternoon schedule, or 160 to the hour, for half an hour. The employés worked in good faith, getting eighty-five cars through, or at the rate of 170 to the hour, without a hitch. Then extra cars were switched on, making up a rush hour condition. In twenty-four minutes 100 cars were put through, or at the rate of 117 in half an hour. This resulted in completely blocking the north track of the bridge, when the trial was called off and the usual afternoon schedule resumed. Although Mr. Poulson claimed that the plan would ultimately be a success, the bridge officials are inclined to believe that no further trial will be made of the scheme.

REPORT OF INTERURBAN STREET RAILWAY COMPANY—The first report of the Interurban company (New York), which includes the operations of the Metropolitan Street Railway, the Third avenue and the suburban lines in the Union system, including about 480 miles of elec ric and horse lines in the boroughs of Manhattan and the Bronx and in Westchester County, shows gross earnings of $21,549,545, an increase of $618,377 over last year and the largest in the history of the combined concerns. The entire revenues of the Metropolitan system were $16,178,563 and the surplus $3,509,339, which is $130,452 less than the amount required for the seven per cent dividend on Metropolitan. This was paid by the Interurban. The Third avenue and the suburban lines earned $5,370,882 and showed a deficit of $141,684. The statement was looked upon as satisfying in view of the deficits alleged in the recent Amory suits. It has been realized for some time that the dividend guaranteed to the Metropolitan was not being earned and that the balance would have to be made up by the guaranteeing corporation. President Vreeland has stated that adverse conditions, such as the torn up condition of the city's streets and the installation of an underground system on some of the crosstown lines made inroads into profits and that operating expenses were increased through the same conditions and the higher cost of labor, fuel and material. The plans for 1904 include the extension of the lines of the Union system in the borough of the Bronx and the adjacent territory and to install in the borough of Manhattan the underground electric system upon most of the lines now operated by horses.

PERSONAL MENTION.

MR. J. C. CADMAN has been elected president of the British Institution of Mining Engineers.

MR. N. ADELBERT BROWN has been appointed professor of civil engineering in the University of Washington, Seattle, Wash.

MR. BENJAMIN CHEW HOWARD, the well-known electrical contractor of Baltimore, Md., passed through New York city last week after a lengthy sojourn in the Adirondacks.

PROFESSOR ROBERT H. THURSTON, of Cornell University, has resigned as a member of the City Water Commission of Ithaca, N. Y.

DR. F. R. TUFTS, tutor in physics at Columbia University, has been given a year's leave of absence to spend in research in Germany.

DR. NORMAN E. GILBERT, A. B. (Wesleyan), Ph. D. (Johns Hopkins), of Hobart College, has been appointed assistant professor of physics at Dartmouth College.

MR. C. L. EDGAR, president of the Boston Electric Light Company, Boston, Mass., was a New York visitor last week, and spent a day with his friend, Mr. Edison, at his laboratory at Orange, N. J.

MR. HARRY S. KRUMM, who has been superintendent of the People's Telephone Company, at Paducah, Ky., since its organiza-

tion, has gone to Fort Washington, Pa., to assume the position of toll line wire chief for the Consolidated Telephone Company.

MR. A. W. HENSHAW, formerly with the General Electric Company, Schenectady, N. Y., has been appointed to take charge of the motor department of the Stanley Electric Manufacturing Company, Pittsfield, Mass.

MR. DAVID HALL has tendered his resignation as chief engineer of the Milwaukee Electric Manufacturing Company to accept a position on the engineering staff of the Bullock Electric Manufacturing Company.

MR. C. W. BARTLETT, the Nebraska representative of the Stromberg-Carlson Telephone Company, Rochester, N. Y., is located at 1635 South Twenty-second street, Lincoln, Neb. His previous address was Kansas City, Mo.

MR. W. G. McKENNAN, for a number of years connected with the Shelby Electric Company, will have charge of the sales department at the New York office, 225 Fourth avenue, in the place of Mr. J. C. Wormley, who has resigned his connection with the Shelby company.

MR. R. F. MAHLER, formerly Chicago manager of the De Laval Steam Turbine Company and the Curtiss-Crippen Engineering Company, has been appointed manager of the St. Louis office of the Bullock Electric Manufacturing Company, with offices at 1501 Chemical Building.

MR. MARTIN D. ATKINS has tendered his resignation as head of the department of physics and electrical engineering at the Michigan Agricultural College, Lansing, Mich., where he has been for the past four years, to accept a similar position at Lake Forest University, Lake Forest, Ill.

MR. MALCOLM C. RORTY, traffic engineer in the main office of the American Telephone Company, Boston, Mass., has recently been elected vice-president of the Telephone Society of New England, an organization for the study of telephone improvement and the advancement of the interests of telephone business.

MR. SIDNEY W. ASCHE, of the Brooklyn Polytechnic Institute, Brooklyn, N. Y., on Monday, October 5, delivered the first of a series of lectures in engineering which he will deliver the coming year at the Railroad Men's Building, Brooklyn, N. Y. There were 185 men present, and thirty-five enrolled for a course of forty-eight lectures.

MR. REYNOLD JANNEY, for the past two years superintendent of the locomobile works at Bridgeport, Ct., has accepted the managership of the Edison Storage Battery Works, Glen Ridge and Silver Lake, N. J. On resigning his position at Bridgeport, he was presented with an elegant solid silver tea service and a beautiful water-color painting by the employés of the company.

MR. CHARLES CUTTRISS, chief electrician of the Commercial Cable Company, returned last week from the Philippine Islands, where he has been superintending the connecting up of the new Pacific cable belonging to his company. Mr. Cuttriss was quite ill while in Manila, but is now much improved in health. He reports the cable working nicely and its service in much demand.

MR. WM. C. L. EGLIN, of Philadelphia, is chairman of the committee for the investigation of the steam turbine which has been appointed by President Edgar, of the National Electric Light Association. The other members are Mr. Frederick Sargent, of Chicago, and Mr. A. C. Dunham, of Hartford. A plan for the work will be outlined immediately and the investigation will be conducted in a careful and thorough manner.

MR. JOHN A. DREW, of the Worthington Company, read an interesting paper, entitled "A History of Pumps, Ancient and Modern," at the first meeting of the season of the Brooklyn Engineers' Club, on the evening of October 8. Mr. Drew sketched the development of pumping machines from the early Egyptian "Noria," resembling the familiar well sweep, to the latest triple-expansion condensing waterworks engines. The paper was illustrated by a large number of lantern slides.

ELECTRICAL SECURITIES.

During the past week, the sensational allegations made in the ship trust suit might have been expected to contribute largely to a general mistrust of the speculative public in financiers in general. The cutting of the dividend on the common stock of the United States Steel Corporation and the statement of the shrinkage in earnings also might have been expected to have its debilitating effect. Then along comes the report of the Interurban Street Railway Company, the operating company which guarantees seven per cent dividend on the Metropolitan Traction and the Third Avenue system of New York city. While the combined earnings of the several properties included in the Interurban company were largely in excess of any previous year in the history of any of the companies, it was not enough to pay the dividend guaranteed by the Interurban company, and, in the case of both the Metropolitan Street Railway and the Third Avenue line, a deficit had to be made up. This, however, is thought to be due entirely to the deplorable condition of the streets of New York for the past year owing to the subway and other engineering operations.

While all these disturbing effects have had more or less to do in influencing speculative conditions, the fact must not be lost sight of that the cereal crop for this year in all probability will eclipse anything which has been known before, and it must also be remembered that the railroads have passed through a record-breaking year and this condition is likely to be continued for some time. On the whole, it is not hard to accept the hope that even though there is evident a slight industrial reaction, it can not in the light of present indications reach any disastrous dimensions.

New York:	*Closing.*
Brooklyn Rapid Transit	32¼
Consolidated Gas	170
General Electric	144
Kings County Electric	150
Manhattan Elevated	130¼
Metropolitan Street Railway	103
New York & New Jersey Telephone	145
Westinghouse Manufacturing Company	172

It is stated that the current fiscal year of the General Electric Company, which ends on January 31 next, will be the best in the history of the company. It is estimated that the decline in the price of iron will add from ten to fifteen per cent to the profits on all machinery turned out by the company. The profits of the company, including the plants recently absorbed, are said to be running at about $1,000,000 a month. The net profits for the year, it is estimated, will probably be equal to the regular dividend three times over.

The earnings of the Brooklyn Rapid Transit Company for the first twenty-nine days of September are as follows: Gross, $1,208,367, against $1,042,944 last year, an average increase of $6,000 a day. From July 1, the gross earnings are $3,837,074, against $3,003,434 in 1902.

Boston:	*Closing.*
American Telephone and Telegraph	122
Edison Electric Illuminating	235
Massachusetts Electric	77½
New England Telephone	122½
Western Telephone and Telegraph preferred	80

The directors of the Edison Electric Illuminating Company have declared the regular quarterly dividend of 2½ per cent, payable November 2 to stockholders of record October 15.

Philadelphia:	*Closing.*
Electric Company of America	7½
Electric Storage Battery common	52
Electric Storage Battery preferred	52
Philadelphia Electric	6
Union Traction	42½
United Gas Improvement	78

The increase in the net earnings of the Electric Company of America for the eight months ending August 31, over the corresponding period of last year, is officially given as 19.6 per cent.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	142
Metropolitan Elevated preferred	53
National Carbon common	17
National Carbon preferred	88
Union Traction common	4
Union Traction preferred	32

The Chicago Telephone Company has issued $1,000,000 of new stock to stockholders, completing the $2,000,000 of new stock put out this summer under the offer of the board of directors last spring. The company's outstanding stock is now about $14,000,000. The authorized capital is $15,000,000.

ELECTRIC LIGHTING.

DES MOINES, IOWA—At West Liberty extensive improvements are projected to the electric light plant.

HICKORY, N. C.—The Thornton Light and Power Company has secured a contract for lighting the city streets.

RAYNE, LA.—The electric light and waterworks plant has been officially tested. It operated satisfactorily.

ALLENSVILLE, KY.—Arrangements have been completed with the electric light company at Guthries to furnish lights to Allensville.

SPOKANE, WASH.—Alexander M. Winston and J. C. Odell have applied for a franchise for an electric light system for the town of Newport, Wash.

HILLBURN, N. Y.—The Rockland Electric Company has secured the contract for furnishing light for several stations on the Erie in this vicinity.

BURLINGTON, VT.—At a meeting of the board of aldermen it was voted to issue bonds to the amount of $50,000 for the construction of an electric lighting plant.

WYTHEVILLE, VA.—The town's electric lights were turned on recently with appropriate exercises at the power-house of the Stone Electric Light and Power Company.

WOODLAND, CAL.—It is stated that an effort will be made to utilize the waters of Cache creek for electric power, to operate street railroads in Yolo and adjoining counties.

MANKATO, MINN.—A new ten-year contract with the Mankato Gas and Electric Light Company for the lighting of the city streets with electricity has been granted by the city council.

PORTSMOUTH, OHIO—The Sciotoville brick plants are installing an up-to-date electric lighting plant. It will have a capacity for at least 1,000 sixteen-candle-power incandescents.

NORTH YAKIMA, WASH.—At a meeting of the city council the ordinance granting a thirty-seven-year franchise to the Yakima Water, Light and Power Company was passed.

CRESSON, PA.—The new electric light plant at Cresson has been put in operation and is giving good satisfaction. Prior to this the current was obtained from the power-house at Gallitzin.

NEOSHO, MO.—R. B. Rudy has purchased the Neosho electric light plant from J. E. McDaniel and Paul Kabus, and states that he will make material improvements in order to improve the service.

DANBURY, CT.—The Danbury & Bethel Gas and Electric Light Company is installing some new electric machinery, which, when it is in operation, will make its plant completely modern in its equipment.

TROY, PA.—The plant of the Troy Electric Light and Power Company has been sold to David J. Fanning. It is said that the company will be reorganized and will give very much improved service in the near future.

HOUGHTON, MICH.—The system of street lighting in Hancock has been changed from the old-style open arc lamps to the new type of incandescent enclosed arc lamps and the system thereby is considerably improved.

TERRE HAUTE, IND.—Plans have been completed for the new power-house of the Terre Haute Electric Company, which will cost $200,000. Work will probably be started in the spring and it is hoped to have the plant in operation before next winter.

CONSTANTINE, MICH.—The new power-house for lighting Constantine and Three Rivers has been placed in operation. The power of the St. Joseph river is used to run the plant, the old dam having been raised thirty inches, thereby greatly increasing the power. Over $200,000 has been expended upon the plant.

McRAE, GA.—The matter of building and operating an electric light service and a car line between McRae and Helena is being considered. Civil engineers will begin the survey shortly, and the indications are that both of these enterprises will be established by the close of the year. The car line will doubtless run out to Suomi Springs.

ATLANTIC CITY, N. J.—The Atlantic City Electric Light and Power Company has secured a ten-year contract for lighting the city streets, by which an ostensible saving of $12,340 per annum will be effected. The city's 400 arc lights, under the contract expiring on March 8 next, cost $105.85 annually. The price under the new contract is $75 per light.

TRENTON, N. J.—Electric light improvement bonds were sold by the South River borough council recently to the amount of $6,500. The contract for the construction work for the new electric plant was awarded to the Sayre & Fisher Company, of Sayreville. This company will also furnish power for the lights by a connection with its plant at Sayreville.

INDIANAPOLIS, IND.—The Hammond Illuminating Company has notified the secretary of state of an increase in capital stock from $350,000 to $2,000,000, making it one of the largest corporations of the kind in Indiana. It purposes to greatly enlarge its plant and to furnish light and power for the four Lake County cities—Hammond, Whiting, East Chicago and Indiana Harbor.

BOSTON, MASS.—The harbor and land commissioners have granted to the Holyoke, Mass., Water Power Company permission to erect a power-house for the generating of electric energy from surplus water just below the dam in the angle formed by the abutment and the canal wall. It is now so late that the company will not be able to begin any construction work this fall, but plans will be drawn during the next few months so that all will be ready to begin in the spring. It is likely that the generating capacity of the plant will in the beginning not exceed 4,000 or 5,000 horse-power. Room will probably be left in the new structure for additional generative capacity.

NEW INCORPORATIONS.

RICHMOND, VA.—Henry County Telephone Company. $5,000.

MADISON, WIS.—Great Northern Power Company. $100,000.

CONCORD, N. H.—The Milford Electric Light Company. $50,000.

OWENSBORO, KY.—The Rural Home Telephone Company. $25,000.

INDIANAPOLIS, IND.—The Libertyville Telephone Association. $500.

ELKHART, IND.—Elkhart Power Company. $500,000. Directors: Winfield T. Durbin, Walter Brown and V. W. Vanfleet.

VIRGINIA, ILL.—Home Telephone Company. $10,000. Incorporators: Henry Goebel, C. E. Rexroat and C. D. Bayliss.

MT. CARMEL, IND.—Union Telephone Company. $10,000. Directors: J. R. Collins, W. B. Hood, Albert Kruger and others.

CHILLICOTHE, MO.—Livingston County Telephone Company. $2,000. Incorporators: J. Miller, M. Miller, A. M. Shelton and others.

MADISON, WIS.—Stoughton Independent Telephone Company. $45,000. Incorporators: Robert Freeman, Clarence S. Pierce and Will G. Whitehead.

ALBANY, N. Y.—Wayne-Monroe Telephone Company. $30,000. Directors: J. A. Driscoll, Rochester; L. T. Yeomans, Walworth; J. Selden Brandt, Ontario.

NEWPORT, NEB.—Newport, Hammond & Southern Telephone Company. $3,000. Directors: C. M. Thompson, L. F. Brown, M. E. Smith and Robert Good.

MOUNTAIN GROVE, MO.—The Mountain Grove Telephone Company. $10,000. Directors: E. H. Farmsworth, W. S. Cangler, L. H. Slaughter, of this city, L. M. Fenner, of Buckhart, and B. V. Morris, of Rockbridge, Mo.

GUTHRIE, OKLA.—Blue Island, Riverside & Hammond Street Railway Company. $1,500,000. Directors: William F. Owen, August W. Miller, John F. Noel, Ira J. Owens, W. S. McCaully and Frank E. White, of Chicago; W. F. Harn, J. F. McMechan and John Throadgill, of Oklahoma City.

HARRISBURG, PA.—The Heimebach Railroad Company; $140,000; directors: Frank Jacobs, Allentown; A. N. Brown, H. A. Thompson, John H. Euenfstueck, Bethlehem; H. F. Weaver, South Bethlehem; George H. Kressler, West Bethlehem. The Northampton Central Railroad Company; $20,000. The Bath & Chapman Street Railway Company; $12,000. The Alliance & Bath Street Railway Company; $75,000. The Township Line Street Railway Company; $65,000. The Alliance & Cherryville Street Railway; $50,000. The Donora & Carroll Street Railway Company; $30,000. The Kane Electric Street Railway Company; $24,000.

ELECTRIC RAILWAYS.

BELLAIRE, OHIO—The county commissioners have granted a franchise for a trolley line from this place to Shadyside.

GRAND RAPIDS, MICH.—The Kalamazoo Valley Electric Company has sent men to Plainwell to estimate the cost of an electric road from Kalamazoo to Grand Rapids by way of Allegan.

NEW LONDON, CT.—The Croton & Stonington Street Railway Company, which is about to build an important trolley line from New London to the Rhode Island state boundary at Westerly, has purchased of the Standard Machine Company the so-called Randall Wharf property as the site for a power station.

BARABOO, WIS.—The Wisconsin Central Traction Company, of Chicago, has assumed all rights, privileges and franchise of the Sauk County Traction and Power Company and purposes to build the projected electric road between Devil's Lake and Kilbourn. The Central company is composed of Chicago capitalists.

BOSTON, MASS.—It is said that within sixty days, if no untoward circumstances intervene, the Newton Lower Falls branch of the Boston & Albany division of the New York Central will be electrically installed. Contracts for the overhead equipment have been let and the work of changing the motive power of the line from steam to electricity will be started at once.

EBENSBURG, PA.—The supervisors of Summerhill Township have granted the Conemaugh Valley Street Railway Company rights of way along certain public highways in the township for a distance of four miles. It is said that this is the last link in the line between Ebensburg and Johnstown, and that the company is now in a position to go ahead with the building of the line.

BOSTON, MASS.—The town of Burlington has instructed the board of selectmen to grant a location to the Middlesex Street Railway Company. The company purposes to construct a line between Arlington and Lowell, with rails in Arlington, Lexington, Bedford, Burlington and Billerica. The route, so far as possible, will be over private land and a double track will be laid.

LANSING, MICH.—It is announced here that the Lansing street railway has been sold to Nelson Mills and M. W. Mills, of Mayville, Mich., and James R. Elliott and George G. Moore, of Port Huron. The price paid is said to be about $175,000. The new owners will improve the system and have signified their intention to build a new line from Lansing to Pine Lake, the right of way having been secured by the previous owners.

WALTHAM, MASS.—The Waltham Street Railway Company opened last week its new line between Waltham and Belmont. Work of constructing this line was begun last Saturday and pushed forward until completed. Wednesday night and Thursday cars were put in operation, as called for in the franchise. The new line starts from Main street in Waltham and passes through Linden street and from Quincy street extension to Tarpelo road.

MARYVILLE, MO.—Surveys are now being made for the proposed electric railway from Parnell through Maryville to St. Joseph, and work will now be pushed as rapidly as possible. The Maryville & St. Joseph Electric Railway Company has been chartered for this purpose, the incorporators being Richard Kuchs, Richard M. Bradbury, Stephen H. Kemp, Clarence E. Bartlette, Adolph Lippmann, Charles E. Gonnell and John W. Thompson.

WORCESTER, MASS.—The Worcester Street Railway Company reports as follows: Earned $17,700 in July and $19,950 in August, with September promising more. The railroad commissioners recently approved an issue of bonds by the Boston & Worcester Street Railway Company to the amount of $250,000, payable in twenty years, with interest at four and one-half per cent, to be used in paying floating indebtedness and in the purchase of property.

CHAMBERSBURG, PA.—Residents of this place, St. Thomas and Fort Loudon have organized the Chambersburg, St. Thomas & Fort Loudon Electric Railway Company. John R. Eberly was made president; Frisby Miller, secretary, and Dr. F. G. Strock, treasurer, all of St. Thomas. An application for a charter has been filed at Harrisburg. The capital stock will be $300,000. The road will run from here to St. Thomas and thence to Fort Loudon, with probably a spur to Mt. Parnell.

RUSHVILLE, IND.—Work on the excavation for the power building of the Indianapolis & Cincinnati Traction Company has been begun. The power plant of the traction company will consist of three large buildings—the main power-house, car barns and repair shop and loop building. The buildings will represent a cost exceeding $50,000, and $200,000 will be expended in equipping the power-house. Work on the grading of the line is progressing rapidly, and this work will probably be completed by December 1.

WOONSOCKET, PROVIDENCE, R. I.—A second survey has been completed by the engineer corps of the Woonsocket Street Railway Company for the double-track Woonsocket-Providence electric passenger and freight short line to be built under the Providence & Burrillville Street Railway Company's charter. The General Electric Company, of New York, is preparing estimates for electric equipment for the line and for the rolling stock for the new road. The line, which will pass through North Smithfield, Lincoln, Smithfield and Centredale, will require about thirteen miles of trackage exclusive of the terminal trackage over existing roads. Mr. E. K. Ray, president of the Woonsocket Street Railway, is the principal promoter of the new line. Construction will likely begin soon and equipment will be delivered as the work progresses.

LEGAL NOTES.

CAR HEATING COMPANY LITIGATION—The Gold Car Heating and Lighting Company, of New York, has announced that the privy council of England has decided that the Gold steam hose coupler does not infringe the Sewall patent, as alleged by the Consolidated Car Heating Company. The Consolidated Car Heating Company appealed to his Majesty the King of England in his privy council from the unanimous decision rendered by the Court of King's Bench for the Province of Quebec (appeal side), Dominion of Canada. The final appeal was argued in July last before the privy council, at London, England. The concluding paragraph in the decision by the lords of the privy council is as follows: "Their lordships therefore have come to the conclusion that the appellants have failed to prove that the respondent has infringed their patent."

MARCONI COMPANY SUED—Suit has been commenced in the United States Circuit Court, at Trenton, N. J., to test the patent rights of the Marconi Wireless Telegraph Company of America. The action is based on the testimony of Emerson Dolbear, of Somerville, Middlesex County, Mass., who claims that he is the original inventor of wireless telegraphy and asks a preliminary injunction restraining the Marconi company from making further use of the invention, and an accounting from the corporation for alleged infringement of his patent rights, which were granted on October 5, 1886. He sold his patent rights to the International Wireless Telegraph Company on March 14, 1903, and this latter company has brought the suit. A similar case has been brought by Reginald A. Fessenden, a citizen of Virginia, who is now living at Bayonne, N. J., and who is a recognized inventor of wireless electrical communication.

WESTERN UNION WINS SUIT AGAINST TELEPHONE COMPANY—The United States Circuit Court of Appeals has rendered a decision reversing the findings of the United States Circuit Court of Boston, Mass., in the case of the Western Union Telegraph Company and others *vs.* the American Bell Telephone Company. A Master's report in the case, which held that the plaintiff could not recover in the suit seeking an accounting for certain shares of stock in companies licensed by the Bell company, under a contract made November, 1879, was confirmed by the United States Circuit Court. Appeal was taken, and the Court of Appeals holds that the plaintiff can recover. When the Western Union Company abandoned the telephone field to the American Bell Company, its patents on telephonic apparatus were turned over, and it appears that its compensation was the contractual twenty per cent of the American Bell's rentals and royalties for seventeen years. The issue turned on the question whether rentals or royalties are not money rentals received as such, or all compensation received by the Bell company for the use of its instruments. The appellate court in its opinion does not recognize the Bell company's claim that the value of the patents could be differentiated into a value for the instruments alone and a value for the use of the instruments.

INDUSTRIAL ITEMS.

THE NATIONAL ELECTRIC COIL COMPANY, Lansing, Mich., has been incorporated. The company is capitalized at $20,000, and will manufacture electric spark coils.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received an order for electric equipment for the Insein shops of the Burmah Railway, in India. The equipment includes power, lighting and fans to replace the old punkahs.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for McBride "Arkless" fuses, states that these fuses are now made for voltages up to 500 volts. They are furnished in any capacity up to and including thirty amperes. These are made to fit any style fuse connection in all styles of fuse blocks.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has recently closed a contract with the Benson Telephone Company, Benson, Minn., and the Red River Valley Telephone Company, of North Dakota, for 400-line generator-call visual-signal switchboards.

THE MOORE ELECTRICAL COMPANY, Newark, N. J., is introducing the Moore portable artificial daylight apparatus for photographic purposes. This is a system of vacuum tube lighting which was given its first public demonstration for use in photography at the Old Guard Fair, recently held at Madison Square Garden, New York.

THE WESTERN ELECTRIC COMPANY, 22 Thames street, New York city, has recently arranged a novel display of electrical fixtures. A whole room is devoted to this exhibit, and it is festooned profusely with the same. Those interested in this line of electrical supplies will, no doubt, find that a visit to this display will be interesting.

THE BALLOU-HUTCHINS ELECTRIC COMPANY, Providence, R. I., is introducing a new automatic time switch which is a considerable departure from the ordinary apparatus of this nature. The switch-operating mechanism is mechanically insulated from the clock movement, ensuring accurate time and successful operation, as well as unlimited capacity.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has sold a 2,000-kilowatt revolving-field generator to the Memphis Consolidated Gas and Electric Company, of Memphis, Tenn. The motor department of the Stanley company will henceforth be in charge of Mr. A. W. Henshaw, formerly with the General Electric Company, Schenectady, N. Y.

THE F. BISSELL COMPANY, Toledo, Ohio, is sending out an attractive circular, listing a number of electrical supplies, including automatic portable hand-lamps, distributing panels, pole platforms, pole seats, pole ladders, cable trolleys, cable messenger cars, marine cable hangers, double arming braces, duplex wire, doubled galvanized steel and iron wire and National telephone cables.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, manufacturer of the Shelby useful light incandescent lamp, has made an important change in its New York office. While the office is still in the Parker Building, 225 Fourth avenue, Mr. W. G. McKennan, who has been with the company for a number of years, will hereafter have charge of the sales department in place of Mr. J. C. Wormley, who has resigned.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, is shipping a number of fan motor orders to various parts of India and South America. Export shipments of Peerless transformers are reported, and a lively domestic demand for these and small direct-current power motors. An attractive addition to the company's trade literature, entitled "Long Service," tells concisely of the efficiency and durability of Peerless transformers.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., has issued a very attractive circular, descriptive of electric air heaters, which it manufactures. The efficiency of these stoves, the manufacturer claims to be, is two watts for minimum and three watts for maximum per cubic foot of air, depending to a great extent on the construction of the building, as well as location of room in which heater is to be placed. Circular will be sent on request.

THE WHITE SEWING MACHINE COMPANY, Cleveland, Ohio, is issuing a handsome bulletin in the interest of the White steam touring car. The first edition, dated Cleveland, Ohio, October, 1903, contains a number of half-tone reproductions of White touring cars and a surface map showing the route of the tour of Mr. James B. Dill, of East Orange, through the Maine woods in a White steam touring car. Mr. Ray D. Lillibridge is the editor of the White bulletin, and the production shows the characteristic excellent treatment which he gives to business literature of this kind.

THOS. E. CLARK WIRELESS TELEPHONE AND TELEGRAPH COMPANY, Detroit and Pontiac, Mich., announces that its business for this fall and winter looks exceedingly encouraging. At the present time, the company is moving into its new factory at Pontiac. Instruments are being prepared for use at the Universal Exposition at St. Louis, where it will have three stations in constant operation. The company is also getting out instruments for two stations for the government work at Washington and Baltimore and numerous orders for colleges, universities, nigh schools, and individual sets for short distances.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has just issued its booklet, "Jeffrey Power Drills for Rock or Coal." Contained therein is a complete line of drills (electric, steam, air and hand power), special steel augurs, "Jeffrey" drill truck, "Jeffrey" standard reel with cable, "Jeffrey" portable electric mine plunger pumps, "Jeffrey" electric hoists, "Jeffrey" standard electric coal cutters, "Jeffrey" electric locomotives, "Jeffrey" all-iron bevel gear jacks, "Jeffrey" water elevators, "Jeffrey" conveyors, "Jeffrey" mortar and concrete mixer and miscellaneous labor-saving appliances. Booklet will be sent on request.

THE CHASE-SHAWMUT COMPANY, 390 Atlantic avenue, Boston, Mass., manufacturer of electric specialties, has purchased and equipped a new and model factory at Newburyport, Mass. Its main office and factory will be moved there about the middle of October, where will be provided increased facilities for handling the work and increasing the output very largely. The company has had a very successful season with its theatrical specialties, and has completed and now has under way switchboards for the following theatres: New York Theatre, Hudson Theatre, New Amsterdam Theatre, New Amsterdam Roof Garden, Metropolitan Opera House, Lyric Theatre, Empire Theatre, New York city; Auditorium Theatre, Baltimore, Md., and Globe Theatre, Boston, Mass.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., reports that it has just shipped several carloads of central energy switchboard equipment to the Fort Worth Telephone Company, Fort Worth, Tex. The capacity of the Fort Worth exchange is 6,000 lines, and the apparatus is of the American company's best grade. This is one of the first large switchboards for independent service where each cord circuit is equipped for four-party selective signaling service, the American company's high and low-frequency selective apparatus having been adopted. In addition to the Fort Worth equipment, a 3,000-line capacity switchboard has been sold to the Kewanee Telephone Company, Kewanee, Ill. This switchboard also is being equipped complete with four-party selective keys.

THE EUREKA ELECTRIC COMPANY, Genoa and Chicago, Ill., has lately furnished new switchboard and telephone equipment for Brownstown Telephone Company, Brownstown, Ind.; East Valley Telephone Company, New Prospect, Wis.; Sidell Telephone Company, Sidell, Ill.; F. W. Gratz, Atwater, Minn.; Tucker Brothers, Virden, Ill.; H. and J. Meyer, Cleves, Iowa; Bedford County Telephone Company, Bedford, Pa.; Davenport & Tipton Telephone Company, Tipton, Iowa; Rohret & Cotter, Oxford, Iowa; Gainsboro Telephone Company, Carrolltown, Ga.; W. H. Hargis, Granville, Tenn.; Taylor-Jeardeau Construction Company, Fullerton, Neb.; Wilsonville Telephone Company, Stockport, Iowa; Golden Rod Telephone Company, Cedar Bluffs, Neb.; Equality Independent Rural Telephone Company, Equality, Ill.; D. L. Groce, Willow Springs, Mo.; Elston Telephone and Electric Company, Muscoda, Wis.; Jewell Telephone Company, Jewell, Iowa; Independent Telephone Company, Durham, Mo. The Eureka company is now housed in its new plant at Genoa, Ill., with increased capacity and better able to take care of its customers than ever in the past, and is distributing its No. 23 catalogue. New bulletins No. 26 and No. 27 are now in press and it will be pleased to forward these to any companies interested.